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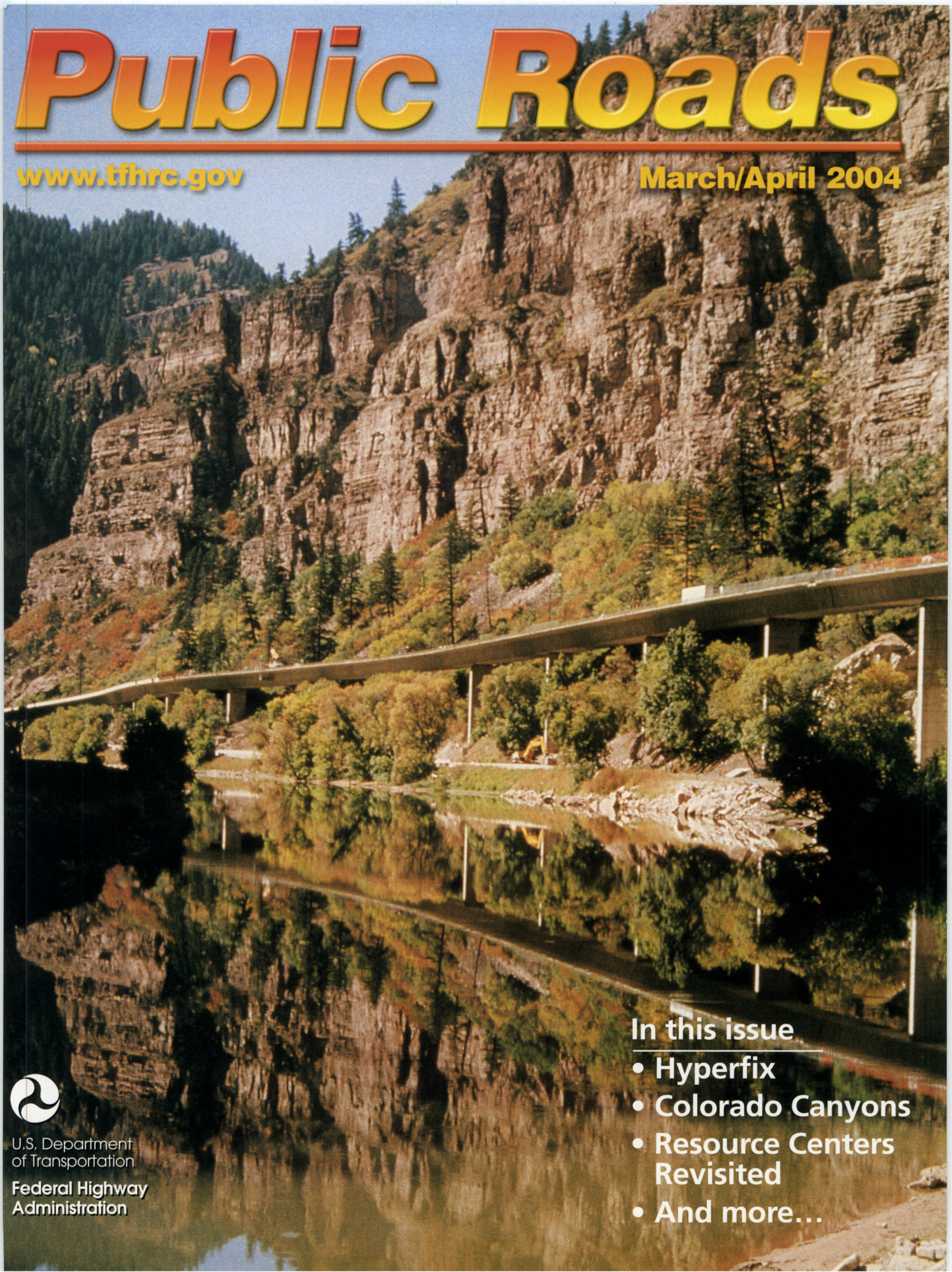
March/April 2004



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U.S. Department of Transportation

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Public Roads

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—featuring developments in Federal highway policies, programs, and research and technology —

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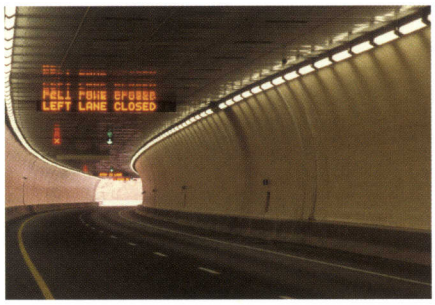

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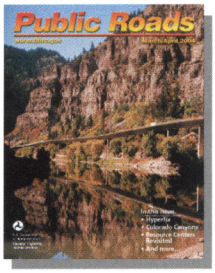

Front cover—Twelve years after its completion in 1992, the project to build Interstate 70 through Glenwood Canyon in western Colorado remains a model of what can be accomplished in the areas of environmental stewardship, safety, and mobility—despite numerous physical, operational, and administrative obstacles faced during construction. *Photo: Joseph J. Kracum, Kracum Resources, LLC.*

Back cover—One major accomplishment of the project in Glenwood Canyon is the enhancement of recreational opportunities, such as construction of ramps that provide kayakers and whitewater rafters safe and convenient access to the Colorado River. *Photo: Joseph J. Kracum, Kracum Resources, LLC.*

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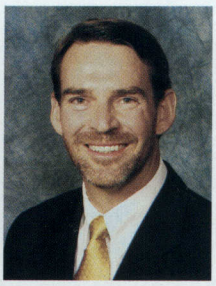
Guest Editorial

Effective Stewardship of the Federal-Aid Highway Program Through Federal/State Partnerships



Each year the U.S. Congress entrusts the transportation community with more than $30 billion in Federal-aid highway funds that are apportioned and allocated to State departments of transportation (DOTs) for highway transportation needs. Conscientious stewardship of these resources is a challenging and vital responsibility.

Stewardship can be thought of as managing another person's property or investment, implying trust and confidence, accountability, efficiency, effectiveness, and quality. To be effective stewards of the public's money, a strong partnership between the Federal Highway Administration (FHWA) and State DOTs must be sustained to ensure that our ultimate customers, the public, receive a good return on their investment. The American public must feel confident that a dollar given to the transportation team is a dollar "best" invested—not through a publicity campaign, but by results they can see, such as reduced traffic congestion, fewer lives lost on U.S. highways, seamless delivery of goods across the Nation, improved livability, and greater environmental protection.

FHWA, State DOTs, and local agencies form the core partnership that supplies the product delivery to our mutual customers. As civic agencies, we cannot do it alone or independently. We must put together a highway program delivery team that successfully uses the best of both public and private communities. The public must have complete trust and confidence that the team can be counted on to deliver quality solutions that meet U.S. transportation needs, efficiently and effectively.

Building and managing our highway team requires a strong partnership and multiple agency coordination, cooperation, and communication. FHWA's responsibility is to provide leadership in moving our Nation's transportation systems toward outcomes that reflect the national interest. In addition, FHWA supports and nurtures State and local efforts toward implementing the highest level of excellence by developing and sharing best practices. State DOTs in turn need to help achieve the needs of the Nation as a whole, in addition to their own unique State needs. Each team member has a role and responsibility to fulfill, and we are challenged to understand and accept these specific roles while integrating them into a cohesive team effort that leads to building and maintaining a successful surface transportation system. As members of a "broader" transportation team, our individual success is directly linked to the success of the team. Our mutual customers deserve quality products from our efforts and need to trust that we will provide that quality.

Our challenge for the future is to continue to work together, proactively, because we are all accountable to our customers. A large part of our endeavors will involve reducing congestion on our roadways, making travel safer, advancing context-sensitive solutions, and enhancing project oversight and management, particularly on projects approaching or exceeding $1 billion, or "megaprojects." These practices include promoting innovative contract and design techniques to "get in, get out, and stay out," developing sound financial management systems, designing our facilities in an environmentally context-sensitive fashion, advancing asset management and congestion management systems, and tapping new technology such as intelligent transportation systems and advanced motorist information systems including 511 systems. Although we possess many tools, talents, and skills, we also must expect that we will develop new approaches to doing business and a new skill set as we move toward the increasingly complex transportation future ahead.

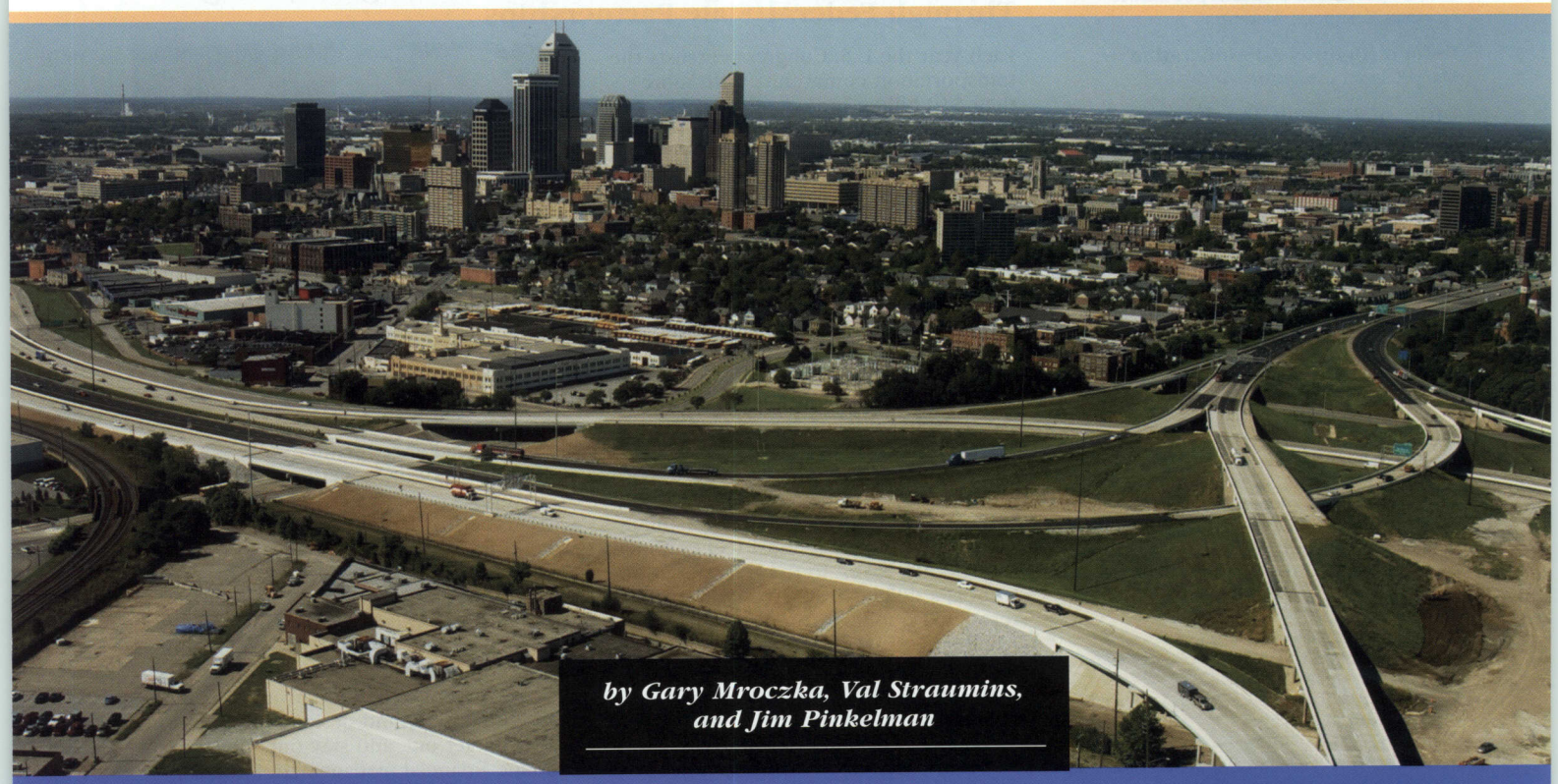
At the Federal Highway Administration and the American Association of State Highway and Transportation Officials, we are committed to improving our efforts and finding opportunities to enhance our working partnership to ensure the delivery of the best transportation system in the world to our customers.

In subsequent issues of PUBLIC ROADS, successful Federal-State partnership case studies will be showcased in a series of articles.

Mary E. Peters
Federal Highway Administrator

John Njord
President, AASHTO
Executive Director, Utah DOT

HYPERFIX 65 70



by Gary Mroczka, Val Straumins, and Jim Pinkelman

Indiana closed a major interstate corridor for repairs and reopened it a month ahead of schedule.

On Interstate 65 and 70 (I-65/70) in Indianapolis, IN, most people—not just the Indiana Department of Transportation's (INDOT) maintenance crews—could recognize the signs of aging infrastructure: potholes, deteriorating joints, and rough bridge decks. Years of service and rapidly growing traffic volumes had taken their toll. When transportation planners review all the options for road rehabilitation, sometimes the best choice may be the "road less traveled," literally.

On May 26, 2003, INDOT and the Federal Highway Administration (FHWA) planned to shut down the combined sections of I-65/70 in the heart of the city for 85 days of rehabilitation. The 5.6-kilometer (3.5-mile)-long project, dubbed "Hyperfix 65/70," would rehabilitate 33 bridge decks and about 56 lane-kilometers (35 lane-miles) of concrete pavement. It also would add capacity with additional travel and merge lanes.

(Above) This aerial shows the north split of I-65/70 and downtown Indianapolis after completion of the Hyperfix project. *Photo: James Kinder, INDOT.*

Before the project began, *The Indianapolis Star* ran an article (March 2003) warning commuters to brace themselves for what could be the "worst construction season ever." The article explained that the city of Indianapolis planned to begin repairing several major downtown streets in preparation for the Hyperfix project. The crews would conduct repair work at more than 20 locations—all at the same time—potentially increasing congestion for downtown commuters.

On July 20, only 55 days after the Hyperfix project began, former Indiana Governor Frank O'Bannon (who passed away September 13, 2003), United States Representative Julia Carson, and other dignitaries proudly opened the $30 million repaired interstate 30 days ahead of schedule. Former U.S. Congressman Andy Jacobs ceremoniously waved a green flag as the State opened the road to cars, trucks, and other vehicles waiting to head northbound on the interstate.

Thanks to meticulous planning and cooperation among government agencies, the news media, the construction team, and the traveling public, the traffic jams that the journalist from *The Indianapolis Star* predicted never materialized. "Hyperfix," says INDOT Commissioner J. Bryan Nicol, "is an innovative model for repairing metropolitan interstates."

The Beginning

Few questioned the necessity of rebuilding the highway and bridges on the I-65/70 corridor. When the

shared Interstate 65/70 corridor first opened in October 1976, it was designed to handle 61,000 vehicles per day. Recent traffic counts by INDOT engineers revealed that more than 175,000 cars and trucks drove this stretch on a daily basis.

Efficiently repairing the busy, deteriorating interstate and its bridges, however, posed a logistical problem. In reviewing its options, INDOT determined that rehabilitating the infrastructure using traditional methods (that is, with partial closures) would take 180 to 200 workdays, possibly requiring two construction seasons, and cost $1 million per day in lost productive time to the highway users. "I directed our engineers to put together a plan to deliver the project in record time," says Commissioner Nicol.

Eventually, INDOT leaders started discussing a total shutdown. Despite disruptions for commuters and other road users, a shutdown would enable the State to complete the project more quickly, safely, and at a reduced cost. More than a year of planning followed with input from all the stakeholders.

Prepping with City Street Repairs

In mid-summer 2002, when Indianapolis began planning for the I-65/70 closure, the city hired traffic consultants to analyze the project's likely impact on city streets. West Street, the local street running parallel to the I-65/70 link, was carrying its design load of 25,000 vehicles daily. The consultant anticipated a doubling to 50,000 vehicles a day during Hyperfix 65/70. Clearly some changes were needed to increase capacity there and at several other chokepoints.

"We had to figure out what we needed to do," says Paul Whitmore, public information officer for the City of Indianapolis' Department of Public Works, "how quickly we could accomplish it, and how we were going to pay for it."

To help Indianapolis prepare its streets for the increased traffic, construction began mid-March 2003, at a hectic pace to finish before Hyperfix 65/70 started at the end of May.

Modifying West Street to increase capacity was the most significant project for the Indianapolis Department of Public Works. The construction contractor added an additional travel lane in each direction by reducing the width of the lanes and cutting into the landscaped median. The contractor also milled the street and put down a new asphalt surface to handle the anticipated heavy truck traffic that normally passes through on the I-65/70 link.

The city added turn lanes, restricted parking during the morning and evening rush hours, and took steps to accommodate additional traffic volumes on corridors connecting the northeastern part of the county to the suburbs. Two key intersections specifically required upgrades to handle the additional volume. One fix involved removing an existing traffic signal to allow free-flowing traffic. The other required removing a concrete median, installing numerous lane shifts, and adding a second right-turn lane. To make sure motorists anticipated the changes, the Indianapolis Department of Public Works posted 600 new signs downtown, on heavily traveled corridors, and as far away as 11 to 13 kilometers (7 to 8 miles) northeast on the restricted left turns.

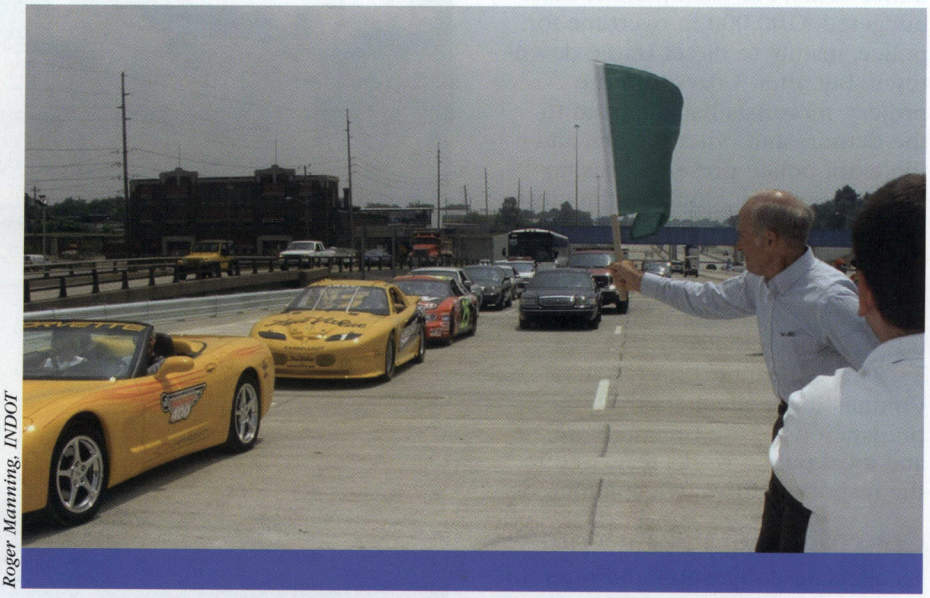
"The media was key in helping people understand the necessary changes," Whitmore adds. "*The Indianapolis Star*, for example, put together a special section on the city street changes just weeks before the project."

Running Smooth Detours

Preparing for the project, INDOT and FHWA were determined to minimize disruption to the traveling public. The I-65/70 corridor, just east of downtown, is not only a major gateway to the city but also a heavily used route for commuters and through traffic.

"The traffic pattern in Indianapolis is commuter-driven so we looked at ways to inform the motoring public and identify alternate routes," says INDOT Operations Engineer Jay Wasson.

The State's Traffic Management Center, the Indiana State Police, and INDOT's freeway service patrol operators, known as Hoosier Helpers, collaborated to keep traffic flowing smoothly. Throughout the project, downtown commuters could use all but one of the exits on either end of the closure. INDOT directed national and regional traffic onto the construction-free outer beltway (Interstate 465). Starting 16 kilometers (10 miles) outside the I-465 beltway and at key locations downtown, INDOT erected the distinctive Hyperfix 65/70 signage directing traffic around the construction zone. Also, INDOT repositioned several portable message signs in conjunction with the overhead dynamic message signs to convey real-time information to the motoring public about possible congestion.



Roger Manning, INDOT

Former U.S. Congressman Andy Jacobs from Indiana waves a green flag at the opening of the I-65/70 corridor on July 20, 2003. He helped obtain Federal money when the downtown portion of I-65 was built.

Heather Hiatt Miller, INDOT

Workers prepare to place bridge deck overlays.

City officials and INDOT used demand management to control congestion. Many businesses in the downtown area, for example, staggered their work hours or encouraged employees to carpool. To minimize noise concerns, INDOT met regularly with downtown residents, businesses, and employees to advise them on the progress of the project.

As the start date approached, INDOT and its partners implemented other precautions to ensure smooth traffic flow but soon discovered the additional efforts were unnecessary. For example, the State budgeted $100,000 in overtime for police, mainly to direct traffic downtown. But after 3 days into the project, motorists had adjusted to the detours and other factors, and the extra police presence was no longer necessary. Similarly, the city established an emergency communication center to handle traffic tieups or other difficulties but closed the center after 48 hours when the tieups never materialized.

"This is a tribute," says INDOT Commissioner Nicol, "both to the preparations of the Federal, State, and local public works team and to the response of the area commuters."

Coordinating Public Transit

To alleviate congestion and offer an alternative for commuters heading downtown, the local transit agency, IndyGo, established the first park-and-ride program in Indianapolis. The FHWA Indiana Division, IndyGo, INDOT, the Indianapolis Department of Public Works, and the Indianapolis Metropolitan Planning Organization all collaborated on the planning. FHWA approved the use of $1 million in funds from the Congestion Mitigation and Air Quality (CMAQ) Improvement Program to support the Hyperfix Park & Ride project from May through the end of 2003.

One week before construction began on Hyperfix 65/70, IndyGo launched the park-and-ride program. The transit company turned to a private vendor to supply 18 buses seating 45 to 55 passengers each to transport commuters from three locations in the northeast quadrant—the area most affected by the closure—to three downtown drop points. The touring buses featured reclining seats, onboard restrooms, mini-tables for laptops, and cup holders for coffee. Buses ran from 6 a.m. to 7 p.m. weekdays and every 15 minutes during rush hours. According to Gilbert Holmes, IndyGo's chief executive officer, between 550 and 600 riders were using the bus service at peak ridership.

"This transit project is a marvelous example of partnership with FHWA, INDOT, the Indianapolis Department of Public Works, and the Indianapolis Metropolitan Planning Organization," Holmes says. "We all joined hands and said, 'Let's make this happen.'"

The spirit of cooperation also extended to the private sector, including a transportation vendor who supplied buses on short notice and parking facility owners who allowed commuters to park in their lots. Two shopping centers and Fort Harrison, a former military establishment that is now a private community, permit-

Heather Hiatt Miller, INDOT

A construction worker smoothes the concrete for the new highway during the Hyperfix 65/70 project.

Heather Hiatt Miller, INDOT

A worker sets up a form for concrete placement on a bridge deck approach.

ted commuters to use their parking facilities so that IndyGo did not have to acquire and prepare additional property for parking.

"This is an incredible community project demonstrating the value of public transit and that people want it to happen," Holmes adds.

Closing for Construction

The schedule was ambitious. The combined I-65 and I-70 highway closed for construction on May 26, 2003. Repairs took place 24 hours a day, 7 days a week. For the first half of the job, the contractor performed pavement removal. Then, after preparing the base for the northbound lanes, the contractor began pouring concrete and flipped over to the southbound side. During the demolition stage, the contractor employed up to 100 people on the payroll, plus the subcontractors' laborers onsite. The paving required 73,600 square meters (88,000 square yards) of concrete pavement and 31,700 metric tons (35,000 tons) of asphalt. Because the full section was closed, the contractor was able to work on up to 20 bridge structures simultaneously.

"The oversight was challenging for our staff," says Tim Conarroe, INDOT project engineer. Twenty-four oversight people covered the two 12-hour shifts. The oversight personnel worked 6 days; then INDOT pulled in employees from the outlying areas to cover the seventh day. In total, Conarroe counted 43 INDOT employees sharing the work of overseeing the project. INDOT oversight totaled 31,680 hours for the 55-day, 1,320-hour project.

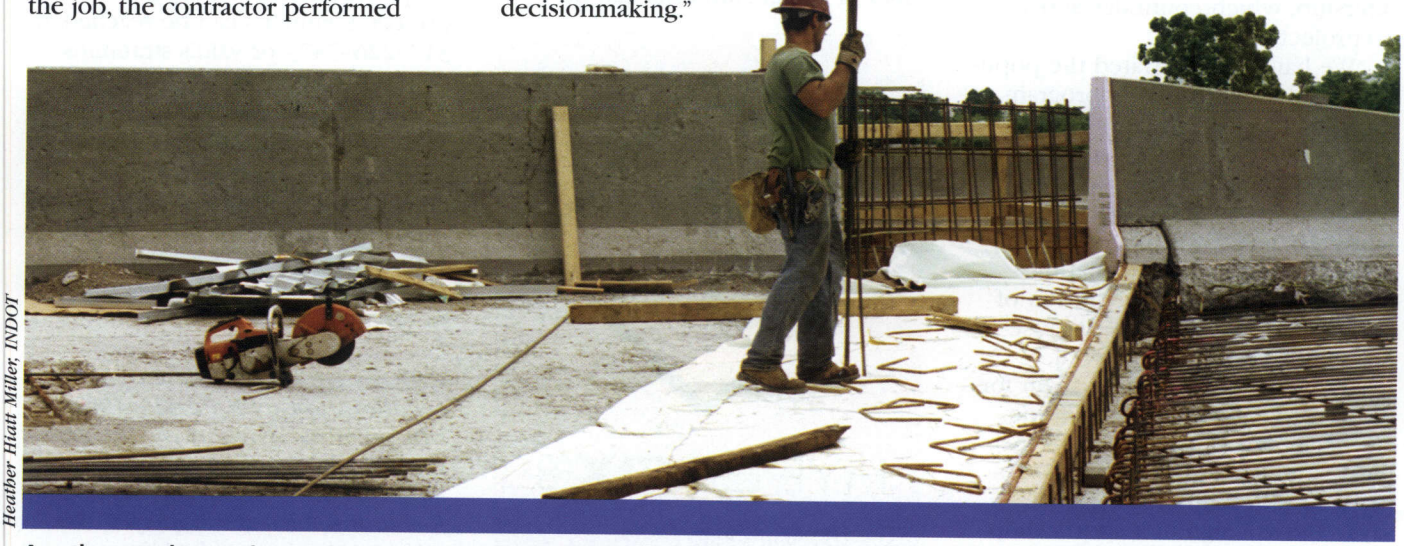
The contractor earned a $3 million incentive ($100,000 per day) for the 30-day early finish. "Our contractor achieved the early finish date by the tremendous human resources and excellent organization of work activity," Conarroe says. "Another key was the excellent working relationships between INDOT, our general contractor, and all the subcontractors. Everything went smoothly without delays or hang-ups for decisionmaking."

Hyperfix 65/70 actually was Phase 2 of the total project. In Phase 1, the contractor assured reliable access to downtown by rehabilitating the interchanges on either end of the project in the traditional way, one lane at a time. This work lasted from March 28 to May 2, 2003. Phase 3, adding an additional lane on the connecting ramp from eastbound I-70 to southbound I-65 and pavement patching on the collector ramps, began on July 30 and continued through August 30.

Generating Community Outreach

Early on, INDOT educated the news media about the repair work, why it was necessary, how it was going to be done, and what the motoring public needed to know to minimize the negative impact of the closure. Acting on guidance from a public relations firm, INDOT decided to "brand" the project by developing a name, logo, and other easily identifiable markings to use on highway signs, public transit, and printed materials.

In January 2003 the public relations agency began a community outreach campaign involving media interviews and notices, public meetings, advertising, displays at local rest stops, and distribution of 5,000 map pads and 250,000 maps showing recommended alternative routes. And, on April 10 State workers began erecting posts to display the Hyperfix 65/70 signage, which shows a running construction worker.



Heather Hiatt Miller, INDOT

Another worker gathers rebar for an approach slab for a bridge deck.

The press releases stressed the lower costs associated with an accelerated timetable and noted the safety advantages of a shutdown to both commuters and workers. The press releases also promoted the long-term benefits such as improvements in traffic flow and patterns that would serve the needs of Indianapolis residents for many years to come. *The Indianapolis Star* polled area residents asking their opinions on a complete shutdown of the facility to permit quick repairs versus a longer project with partial closures. By a 2-1 margin, residents indicated a preference for closure.

"Because we partnered with the news media throughout the process," Commissioner Nicol says, "that first day we did not have the gloom and doom gridlock with the whole city shut down. People changed their travel behaviors, and it was a huge success."

Permanent Changes

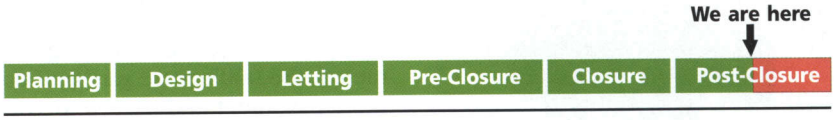
"Hyperfix has been a catalyst for many good things," Nicol says. Indianapolis retained the street improvements, for example, that added capacity to West Street. Many of the restrictions on left turns and parking have improved the traffic flow so well that they remained in force even after completion of the Hyperfix 65/70 project, and the public works department is evaluating making them permanent. Buses still use the software that changes traffic signals to extend green lights. And IndyGo and city leaders are encouraged by the increased bus ridership, which continues above preproject levels.

"We have demonstrated the popularity of the park-and-ride program, so we're seeking funding to continue it and extend it to other areas of Indianapolis," Holmes says.

According to Whitmore, the word "Hyperfix" has become a household term for Indianapolis residents, conveying the notion of an *efficient* fix or repair. Because the public responded so well, INDOT may use the name again for future projects of this magnitude. "Hyperfix has become part of the local language as our residents apply it to different situations," he says. "I saw a sign in a sports shop the other day noting, 'Let [us] Hyperfix your game.' "

Project Timeline

INDOT's Hyperfix Web site featured a project timeline to keep the public notified of progress at a glance. With each new stage, INDOT moved the arrow indicating completed stages in green, and stages to be completed in red.



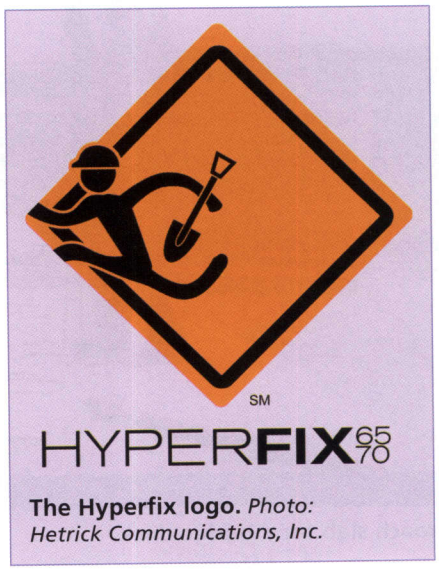
The site also included an explanation of the activities that would occur at each stage and projected calendar dates for completion:

- **Planning**—Evaluating the best possible solution to achieve efficiency and effectiveness.
- **Design**—Developing the working plans that will constitute the scope—or magnitude—of the project.
- **Letting**—Preparing all the necessary paperwork and awarding the contract to the lowest qualified bidder. This project was let on January 22, 2003.
- **Pre-Closure**—Preparing to close I-65/70. All lanes were to remain open to normal traffic between the hours of 6:00 a.m. and 9:00 p.m., though some lane restrictions might be necessary. All work was completed by May 21, 2003.
- **Closure**—Closing the mainline I-70 and I-65 roadways between the north and south splits from May 26 through July 20, 2003.
- **Post-Closure**—Completing work such as pavement patching, shoulder reconstruction, and ramp resurfacing of northbound and southbound I-65 and eastbound and westbound I-70 in the south split interchange area. The project was completed on September 3, 2003.

Gerard (Gary) Mroczka, P.E., manager of special projects at INDOT, worked on planning the Hyperfix 65/70 project from the start. He currently serves as INDOT's division chief of design. Mroczka can be reached at 317-232-5226 or gmroczka@indot.state.in.us.

Valdis (Val) Straumins is the field operations engineer with the FHWA Indiana Division and the FHWA liaison for the Hyperfix 65/70 project. He participated in all aspects of the project. Straumins can be reached at 317-226-7479 or valdis.straumins @fhwa.dot.gov.

Jim Pinkelman was formerly senior public affairs officer in the FHWA Office of Public Affairs. He is now deputy director for communications in the U.S. Department of Justice's Office of Justice Programs in Washington, DC.



The Hyperfix logo. *Photo: Hetrick Communications, Inc.*

INDOT's Division of Research, in collaboration with Purdue University, prepared a report on Hyperfix that will be available to other States by early 2004. For more information, visit the Hyperfix Web site at www.in.gov/dot/div /specialprojects/hyperfix.

Guidelines demonstrate how agencies can apply unified command to managing highway emergencies.

Coordinating Incident Response

by K. Craig Allred

Highway incidents vary in type and scale—from life-threatening traffic-stoppers such as a multivehicle pileup or hazardous material (hazmat) spill on an Interstate to a minor no-injury, one-car crash into a stop sign on a residential street. Because more than half of the situations involving traffic congestion are generated by incident-related delays, highway agencies have a major stake in the efficient management of roadway incident scenes to restore normal traffic flow as quickly as possible.

Highway agencies typically have no direct control over how quickly a roadway is cleared after an incident because emergency scenes are controlled by the first-response agencies that have statutory jurisdiction (fire, emergency medical services, and law enforcement). Highway agencies usually are considered "second responders," with a mission to clear the roadway and restore traffic flow after the first responders have addressed the primary mission of protecting public safety and health. In practice, first and second responders usually cooperate to recover normal traffic flow as quickly as possible. But what happens when a crash blocks the roadway longer than necessary, and highway agencies have no influence on decisions about how to manage the incident?

In the 1970s, fire services developed the concept of "unified command" as a way to take into account the missions of all responding agencies when making decisions at the scene of an incident. The ultimate goal was to serve the public interest most effectively. Incident management systems (IMS) were developed to provide the organizational framework for applying the concept of unified command.

The *Model Procedures Guide for Highway Incidents*, a draft document developed by the National Fire Service Incident Management System Consortium, shows how an IMS used for many years by the fire service and emergency management agencies can be applied to various types of highway incidents.

Funded by the U.S. Department of Transportation's (USDOT) Intelligent Transportation Systems (ITS) Public Safety Program, the guide adapts the consortium's IMS to highway incident operations. The document provides examples of command structures for a wide variety of highway incident scenarios—from terrorist events to winter storms, parades, hazmat spills, and typical motor vehicle crashes.

(Above) An incident management system can help emergency responders, police, firefighters, department of transportation personnel, and towing operators coordinate their responses and clear this overturned truck quickly and effectively. *Photo: Karen Haas.*

Safety and Traffic Flow: Important Objectives

The *Model Procedures Guide for Highway Incidents* addresses the need to balance the safety of motorists, responders, and victims with the need to restore traffic flow. The Model Procedures Committee encourages incident commanders to consider the following factors when managing a highway incident:

- Provide emergency services and remove the traffic blockage as quickly as possible
- Protect responders (and those in their care) from being struck by moving vehicles
- Protect motorists, passengers, and cargo from the hazards of the incident
- Facilitate the movement of emergency response vehicles
- Facilitate traffic flow past the incident and throughout the region

Highway agencies can achieve many benefits from working with other responding agencies to adopt common guidelines for managing highway incidents. Written guidelines provide a standardized, predictable approach and may be applied routinely. They provide a training tool for responders, offer a baseline for critiques and reviews of incidents, and make the commander's

Members of the Incident Management Procedures Committee

Gene Chantler, Deputy Chief (ret.), Poudre Fire Authority, Fort Collins, CO

K. Craig Allred, ITS Public Safety Program Coordinator, USDOT

John Amrhein, Sergeant, San Bernardino (CA) County Sheriff's Office

Wayne Bindas, Deputy Chief (ret.), Hartford (CT) Fire Department

Ken Brooke, Mitretek Systems, contractor to USDOT ITS Public Safety Program

Dave Helman, Office of Operations, Federal Highway Administration, USDOT

Bob Neamy, Deputy Chief, Los Angeles City Fire Department

Ron Miner, Southeast Regional Business Development Manager, Mission Systems Sector, Northrop Grumman

Bob Ricker, Lieutenant, New Jersey State Police

operations more effective. Written guidelines either can reflect strict policies or allow flexibility in managing incidents.

Scenario-Based Guidelines

The *Model Procedures Guide for Highway Incidents* contains a series of scenarios, with an example for each scenario of a complete, systematic organizational structure based on the IMS. The structure is designed to provide the major functions of command, operations, planning, logistics, and finance and administration. Local agencies decide how to provide staffing for standardized tasks.

The committee designed this IMS for use during all types and sizes of highway incidents, from routine mechanical breakdowns and crashes to severe weather and terrorist events. The IMS enables the organizational structure to expand and contract according to the severity and circumstances of the incident, facilitating a smooth transition between single-unit responses and multiagency operations.

The IMS builds the organization from the ground up, adding functional units for new activities. The incident is partitioned into manageable tasks, and the best-qualified response resources are assigned to each need. As the incident grows in complexity, the system maintains a safe span of control and ensures that all activity is conducted under a single chain of command. The IMS ensures the safety of responders, crash victims, and motorists, while responders mitigate the impact of the incident on traffic flow and the surrounding community.

The concepts in the guide were proven effective by emergency service crews, who also fine-tuned the IMS in the field over nearly 30 years, and the American National Standards Institute codified IMS as National Fire Protection Association Standard 1561. Nonemergency responders—such as transportation, public works, and public health agencies—also can be incorporated into the IMS organization. The terminology used in the guide was chosen carefully to convey a uniform message to users from all response professions and for all levels of Government.

In addition, the IMS recognizes that all highway incidents are managed under the authority of the agencies that have statutory jurisdiction. Multijurisdictional incidents may be managed under a unified command structure that includes representation from each jurisdiction. Assisting and supporting agencies also participate by contributing resources, onsite agency representatives, and liaison or information channels.

Strategy, Tactics, and Tasks

The guide stresses the importance of following the IMS organizational procedures for small incidents as well as larger ones. The practice and training afforded in the more numerous smaller incidents will ensure smooth operation when larger ones occur.

Even for a simple incident—a car pulled over for a traffic law violation—the guide urges that responders maintain the IMS, with the role of incident commander always filled (in this case, by the sole police officer at the scene). The three levels of the IMS command structure are:

1. Strategic level: determining the overall direction and goals of the incident
2. Tactical level: determining the objectives that must be met to achieve the strategic goals
3. Task level: assigning tasks that will meet the tactical objectives

In the simple, single-unit response, the incident commander determines strategy and tactics and supervises the crew doing the tasks. If the incident becomes more complex and requires more resources, the initial commander requests additional personnel. When a higher-ranking officer or senior supervisor arrives, that individual assumes command and reassigns the original commander. As a situation becomes increasingly complex, the strategic level can expand. The incident command structure could enlarge to a unified command if several departments or jurisdictions are involved, and a level of section leaders could be added, with many people staffing the tactical and task levels below.

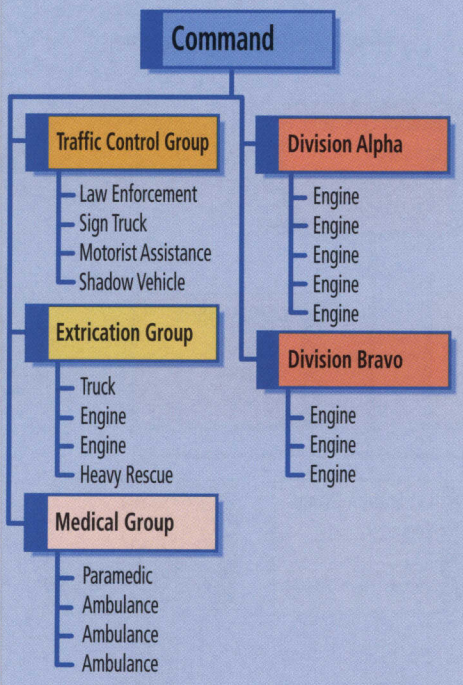
Establish an IMS First

Because a major incident initially has more tasks than staff resources to accomplish them, the tendency is to jump in and start the tasks immediately rather than establish an IMS. "This is a major error," the

Karen Haas

Incident management systems can help drivers avoid long traffic delays like this one, caused by an overturned livestock truck on an interstate highway in Pennsylvania.

Division/Group Designation



Source: Model Procedures Guide for Highway Incidents, Draft, March 2003.

guide warns. "The lack of direction will result in confusion and lack of coordination. This increases the risks to emergency personnel and decreases the likelihood of a successful operation."

The IMS creates organizational subcomponents to direct operations in specific geographical areas (for example, sections of a highway) or to manage incident-related functions (such as care of injured). Called divisions or groups, the subcomponents reduce the span of control to smaller, more manageable units. Establishing divisions or groups and assigning them responsibilities early in the incident provides an effective organizational framework to build on. After establishing divisions and groups, the incident commander can concentrate on overall strategy and assign tactical objectives and resources. The supervisors of each division and group manage their assigned resources to complete the tactical objectives, communicating their needs and progress to the commander.

This system reduces overall radio communications, enabling responders to transmit critical messages and enhancing the safety of those on the scene. The supervisors control both the position and function of each of their assigned companies and continuously monitor all hazardous situations and risks to personnel, ensuring safe and effective operations.

Transportation Roles In the IMS

"Emergency services are well-accustomed to using IMS for all types of incidents," says Ken Brooke, principal, Mitretek Systems, a member of the committee. "Transportation is one of the newer participants, but it fits smoothly into the IMS organization."

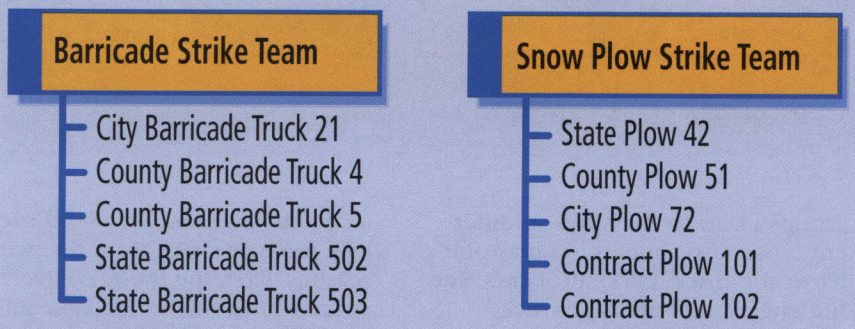
Among many other specialized resources and skills, transportation resources can provide emergency roadway repair, mass transport of victims, traffic control and management (Traffic Management Centers), assistance setting up dams and dikes or applying absorption materials, and construction and demolition equipment and operators.

Technical specialists from the transportation community can be drawn from transit, airport, pipeline, and rail authorities, plus highway authorities in charge of bridges, toll roads, tunnels, and roadways (State DOTs, departments of motor vehicles, and public works). These agencies have a wide range of training, experience, capabilities, supplies, and apparatus types, but they do not have the sort of operating procedures that emergency service agencies have in place—namely, the practice and experience of setting up an efficient, multiagency, emergency command structure and communications system.

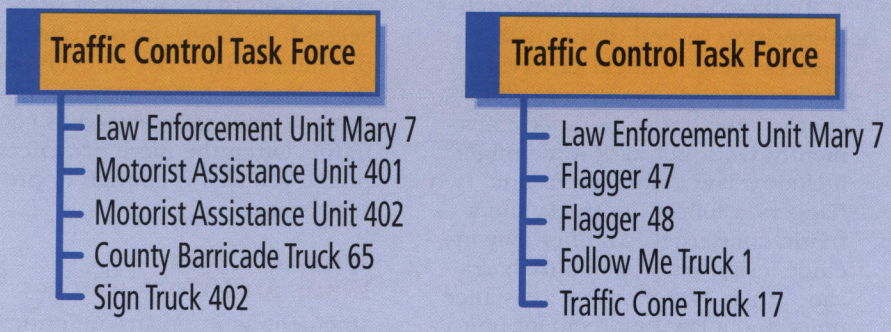
Managing Transportation Resources

During an incident, transportation resources can be managed efficiently by organizing traffic-control strike teams and task forces. Strike teams are groups of up to five units of the same type of resource—for example, five snowplows. Task forces are

Traffic Control Strike Teams



Traffic Control Task Forces



Source: Model Procedures Guide for Highway Incidents, Draft, March 2003.

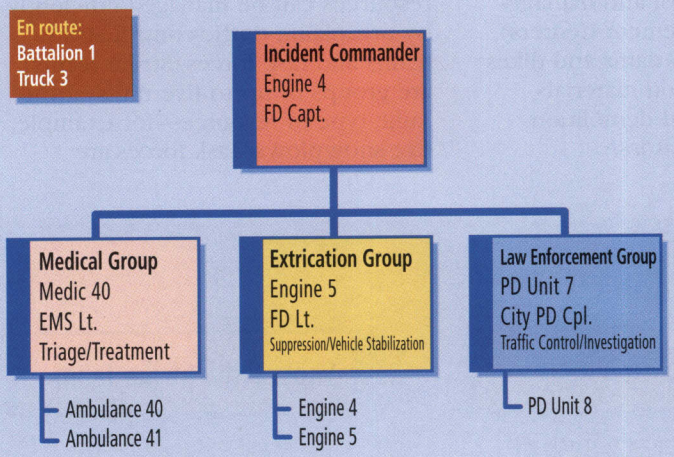
A Sample Scenario

The *Model Procedures Guide for Highway Incidents* walks responders through several highway incidents, showing responses to changing or escalating situations. Below is a shortened version of one scenario, illustrating a common highway incident and how the command structure typically changes as the incident unfolds.

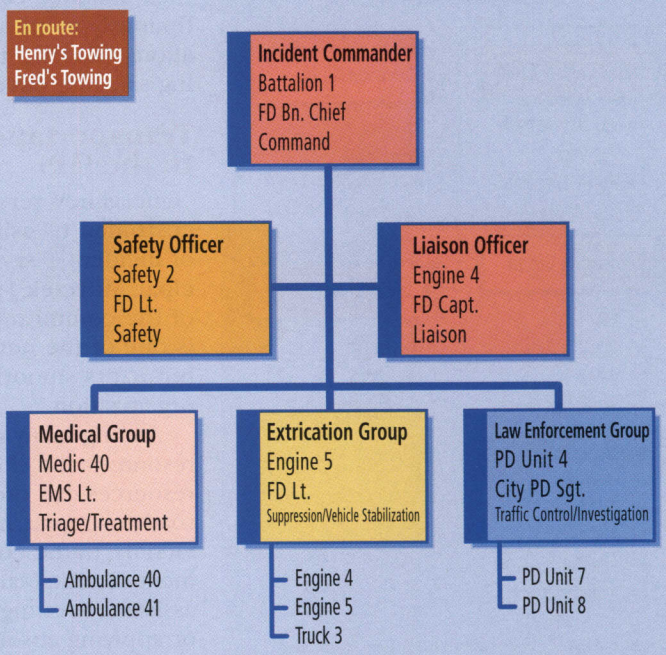
Stage One

A two-vehicle crash with injuries is reported. Two police department (PD) units, one fire battalion chief, two fire engines, and two emergency medical services (EMS) units are dispatched. Fire Engine 4 arrives first, closely followed by the EMS and police units. The battalion chief is delayed in traffic. The captain of Engine 4 assumes command, provides dispatch with a sizeup report, and asks for an additional fire truck (Truck 3) after learning that the occupants of one vehicle are trapped. He assigns the Engine 5 officer as the extrication group supervisor, with Engines 4 and 5 assigned to extrication. He assigns Medic 40 as medical group supervisor with Ambulances 40 and 41 as his resources. He assigns the corporal in PD Unit 7 as law enforcement group supervisor and assigns PD Unit 8 as his resource.

Reorganizing the Small Response Using Groups



Using Command Staff on a Highway Incident



Stage Two

Soon, the battalion chief, Truck 3, and the safety officer arrive, as well as a city PD supervisor (PD Unit 4). The incident commander assigns Truck 3 to the extrication group and the safety officer to his command staff. After briefing the battalion chief on the situation, Engine 4's captain transfers command to him. The new commander then reassigns Engine 4's captain as liaison officer to work with the traffic management center (TMC), which has been in contact with dispatch, concerned about the increasing traffic congestion due to the crash. The city PD sergeant is assigned as law enforcement group supervisor and immediately requests two wreckers to remove the vehicles.

groups of up to five units of different types of resources, such as one barricade truck, two patrol cars, one fire engine, and one sign truck.

A single barricade strike team can combine city-, county-, and State-owned barricade trucks. Likewise, a snowplow strike team can include city, county, State, and contract plows.

Traffic-control task forces, each comprising several different resources under a single supervisor, can set up and operate a roadblock, checkpoint, merge, or taper conveniently. One such task force might include a law enforcement unit, two flaggers, a follow-me truck, and a traffic cone truck. Another may include a sign truck, a county barricade truck, two motorist assistance units, and a law enforcement unit.

The guide recommends that incident commanders consider assigning a law enforcement unit with each task force or strike team for two reasons. First, the traffic-control strike team vehicles are large and hard to maneuver, and they do not have the special right-of-way privileges of emergency vehicles. For example, a police escort can assist them in making their way through congestion to the incident scene. Second, although uncontrolled traffic presents a major risk to everyone on the scene, motorists may not obey flaggers who are assigned to control traffic. Often the mere presence of police vehicles is enough to preserve order.

Write It Down: Plans and Worksheets

"Incident action plans are critical for the rapid, effective control of emergency operations," the guide states.

The guide offers several examples of incident management planning sheets. Action planning starts when the incident commander identifies the strategy—what has to be done. Then the commander or the operations section chief selects the tactics (how, where, and when). An incident action plan also provides for necessary support resources, such as traffic control, transportation vehicles, extrication tools, and law enforcement. The plan is a continuous work-in-progress. Information must be gathered and analyzed so the plan may be modified as needed.

"As an incident escalates from a few agencies to a major operation," Brooke says, "the incident commander may need to track where all the resources are committed on the emergency scene. That's why it's important to use a tactical worksheet."

Stage Three

The safety officer determines that the passing traffic is the main hazard to the responders. He also notices that the guardrail was significantly damaged. Although the scene is protected, he sees problems building in the traffic backup, as drivers become frustrated while trying to negotiate the blockage. At the same time, the growing traffic congestion is beginning to stretch the capabilities of the PD units directing traffic. They tell their law enforcement group supervisor that they need more units so they can begin their investigation and prepare reports. The supervisor asks the incident commander for more resources.

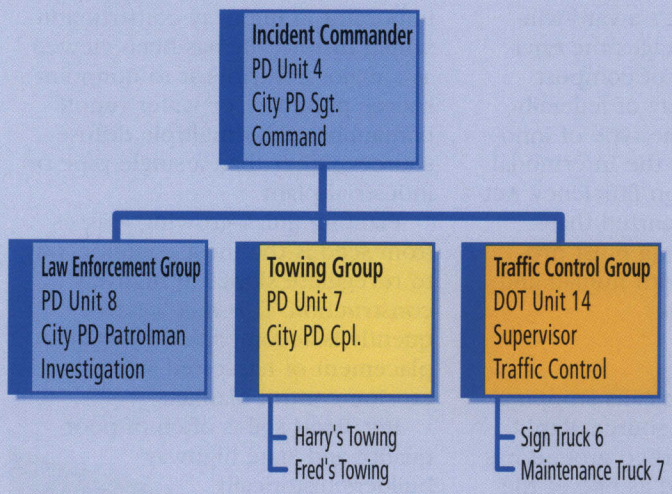
Checking with the TMC, the liaison officer learns that the backup is beginning to cause major traffic problems along the arterial, stretching more than a mile in each direction. After checking with the commander, the liaison officer asks for additional support from the TMC. The county DOT tells the TMC that it is sending a maintenance truck and a sign truck, along with a supervisor.

Meanwhile, the extrication group removes the trapped occupants, who refuse transport to a hospital because their injuries are minor. Only a small amount of coolant has leaked from the vehicles, and the crew from Truck 3 covers the pools with absorbent. At this point, the incident commander releases the fire department resources and then transfers command to PD Unit 4.

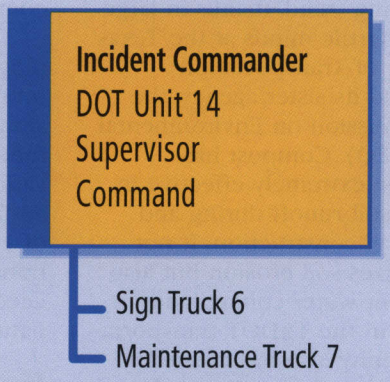
Stage Four

After the towing company finishes loading the second vehicle, command is turned over to the DOT supervisor as the law enforcement units leave the scene.

Reinforced Response from Traffic Management



Conclusion of the Incident



Stage Five

The remaining units perform repairs and deal with traffic congestion for 2 more hours. When repairs are done and traffic returns to near-normal flow, the incident is terminated, and all remaining units are released.

Source: Model Procedures Guide for Highway Incidents, Draft, March 2003.

The guide offers several examples of tactical worksheets designed to help the commander (and divisions and groups) document where resources are committed and what other resources are available, what organizations are participating, and where they are assigned. The sample tactical worksheets also include a template for a sketch of the incident area.

Using a standardized format makes the information more accessible to many parties, including newly arriving commanders. The information on the worksheets is valuable in post-incident analysis and cost recovery.

Next Steps

The *Model Procedures Guide for Highway Incidents* is scheduled for publication in summer 2004. Hard copies will be available from Fire Protection Publications, a department of the College of Engineering, Architecture, and Technology at Oklahoma State University, by calling 800-654-4055 or visiting www.ifsta.org. It is also available online at www.ims-consortium.org/highwaydraft.pdf.

The new guide will join a series of similar publications, also produced by the same organization, that present recommended ways of applying the IMS to various incident types—from the traditional firefighting domains of structural and wild land fires to highly specialized operations involving hazardous materials, structural collapse, and mass casualties.

"After we finalize the guide," says Model Procedures Committee Chairman Gene Chantler, "the challenge will be getting people to use it." Agencies never know when an emergency will strike, or when they may need to participate on a response team.

K. Craig Allred is the ITS public safety program coordinator in the Federal Highway Administration's ITS Joint Program Office in Washington, DC.

For more information about the draft Model Procedures Guide for Highway Incidents, *visit www.itspublicsafety.net/fire.htm.*

Erosion Control with Recycled Materials

by Timothy Barkley

Texas produced an award-winning program for using compost to control soil erosion along roadways.

The use of compost to control roadway soil erosion is a growing trend, thanks in large measure to fertile minds at the Texas Department of Transportation (TxDOT) and its sister agency, the Texas Commission on Environmental Quality (TCEQ). Compost has proven to be extremely effective in preventing soil runoff during and after roadway construction. It not only minimizes soil erosion but also helps prevent water contamination. And its use in the TxDOT transportation community also has created a dynamic market for locally produced compost. In fact, *Biocycle* magazine contends that TxDOT is the largest market for the material in the Nation, using more than 306,000 cubic meters (400,000 cubic yards) of compost in fiscal year 2003.

The Lonestar State's award-winning program encourages the environmentally safe use of compost along the rights-of-way of federally funded highways—the type of innovation envisioned by the Intermodal Surface Transportation Efficiency Act of 1991, which recognized that transportation planning must proceed with care for both human and natural environments.

How It Began

Controlling erosion means stopping soil movement at its source. Rapid revegetation of disturbed ground has long been recognized as one of the best and most economical ways to minimize the loss of soil and the resulting pollution of water resources. This measure is especially important in highway construction, which historically has been viewed as a major contributor to nonpoint source pollution, or water runoff contaminated by multiple diffuse sources rather than a single pipe or industrial plant.

Planting quick-growing grasses from seed is the most common way to revegetate slopes in highway construction. This method frequently is accompanied by manual placement of harvested straw or erosion control blankets.

But Texas soil is often of poor quality, and State highway builders historically

In this April 2003 demonstration, conducted on I–27 in Amarillo, TX, workers using pneumatic blowing equipment apply compost to control erosion.

All photographs: TxDOT.

have had difficulty revegetating roadsides after construction. With little or no organic material available to help retain moisture and provide nutrients to sustain vigorous plant growth, many projects have caused severe erosion. Correcting this erosion has proven to be expensive, both in terms of remediation costs and in environmental fines issued for failure to control runoff.

This situation might have continued if it had not been for a chance meeting between TxDOT Landscape Architect Barrie Cogburn and TCEQ Program Specialist Scott McCoy at a seminar on compost conducted by McCoy's agency in 1996. Cogburn recalls listening to the speakers: "What really struck me was the volume of organic material that we put in our landfills every year. I knew from years of working in the field that on many projects we must clear vegetation and it goes into our landfill and a few years later we bring that same product back in the form of mulch or a wood-fiber blanket, and to me we're paying for it twice. We have such problems getting grass established because we don't have organic matter in our soil, yet here is this waste that's going to the landfill."

TCEQ had been telling Cogburn that the agency had been trying to convince cities in Texas for years to compost their organic waste. Many were giving it away to the public, but most of them were unable to find a market for the great volume of material. Cogburn adds that she thought, "They can't get rid of this organic product, and we can't get enough of what we need. There's got to be some bridge here."

Cogburn and McCoy discussed the situation and began thinking of ways that TxDOT might use compost in roadway construction. Since it was a win-win situation for both agencies, the idea made perfect sense. TxDOT officials believed the idea was at least worth a try. But there was a hurdle to overcome.

These soil erosion blankets along Spur 208 in the Dallas area failed to establish grass.

"The very first thing we had to do was write some kind of specification," TCEQ's McCoy explains. "To get [TxDOT] to buy into this, we had to provide them with a tool they could use."

Writing a compost specification, though, turned out to be far more complex than either Cogburn or McCoy had expected. "Barrie is a landscape architect, and I'm a plant soil scientist," McCoy says, "and neither one of us is a specification writer. So we called in composters from across the State and looked at everything we could find, including information from other States and the U.S. Composting Council, and we put it together. It took us about 6 months from start to finish."

A Demonstration Project

With the specification in hand, Cogburn and McCoy could conduct a compost demonstration project at an actual road construction site. The location they selected was a slope on Interstate 20 near Big Spring, in west Texas. But Cogburn and McCoy encountered an unexpected problem. "The wind was blowing about 40 miles per hour [64 kilometers per hour], and we were worried that the compost would blow away," McCoy says. "So what we decided to do was blend wood chips at 50 percent in the compost. This worked so well that it eventually became our erosion control specification [which should not be confused with the compost specification]."

The slope where Cogburn and McCoy applied the compost and wood chips had been plagued by erosion problems since 1968. Over the years, TxDOT had tried a variety of traditional products that temporarily protected the slope but did little to improve the soil. Cogburn and McCoy's mixture produced dramatic results. Within 8 weeks, vegetation was reestablished on the slope, and Cogburn and McCoy's compost solution was validated for that test case.

Despite the difficulty Cogburn and McCoy had in writing the initial compost standard, Cogburn acknowledges that their strict selection was worthwhile in the end. "It was a good lesson," she says. "I know now that a strong specification solves so many problems. If we just accepted any old compost, we'd be getting some at job sites that was of good quality and some that wasn't, and it wouldn't be fair to the good-quality producers to compete with the people who were just hauling a 'bag of dirt.'"

Full-Scale Use

Today, composted manure makes up about half of the compost used in Texas road projects statewide, followed by composted yard trimmings and biosolids (organic sewage matter treated and processed for fertilizer). Projects in San Antonio use

Composted dairy manure is applied to Spur 208 in Dallas.

As shown in this demonstration, another way of applying erosion control compost uses side discharge equipment that distributes compost evenly in a wide pattern.

yard trimmings and composted biosolids produced by the city, while only yard trimmings are used in Houston. TxDOT's standards allow the use of Class A biosolids—treated sewage—but not Class B biosolids.

There is a big difference between these two classes, Cogburn notes. Class A biosolids are those that the U.S. Environmental Protection Agency (EPA) has deemed clean enough to sell to the public to put on vegetable gardens. Producers must prove that the material has reached an internal temperature of 73 degrees Celsius (132 degrees Fahrenheit) and has stayed that hot or hotter for 15 days, the theory being that all pathogens are eliminated. Class B biosolids have been treated, but not to the same degree, so it is illegal to sell them to the public.

To date, Cogburn and McCoy have held more than 30 workshops for TxDOT employees throughout the State. In addition to educating employees about compost, the workshops enabled Cogburn and McCoy to combat preconceptions that the material has an offensive odor. Attendees had a chance to smell the compost up close.

"It smells like good, earthy soil, not like any of its original constituents," Cogburn says. That's important, she notes, because if TxDOT employees understand that crews are putting down a safe and aesthetically acceptable material on roadsides, they will be able to alleviate any concerns raised by nearby residents.

The original TxDOT compost specification was superseded by a new specification effective in February 2003, which draws on TxDOT's experience in acquiring compost since the program's inception. "Prior field tests proved unreliable, and the new test methods were better suited for testing compost," Cogburn says. She notes that the other major change mandated by TxDOT is the approval of the Seal of Testing Assurance (STA) program, administered by the U.S. Composting Council for any compost used for erosion purposes.

McCoy adds, "We thought this was a good way to have an even playing field for all the composters. We were the first State DOT to approve the STA program. All the composters have to go through the same lab and the same protocol."

TxDOT uses three compost applications. One is general-use compost, which is 100 percent compost. This is the compost specified by landscape architects for purposes such as amending soil for a tree-planting project. General-use compost is also the kind of compost that TxDOT's maintenance personnel might use to top dress a roadside park.

The second is compost-manufactured topsoil, used in fairly flat locations with poor soil quality and shallow slopes. "We can mix in about an inch of compost over the top and drag a till through it to kind of incorporate it lightly," says Cogburn. "And the third situation is where we have a steep slope, and we would traditionally have used a soil-retention blanket. In those areas, we're advocating what we call erosion control compost, which has a 50-50 blend with wood chips."

Economic, Environmental Benefits

The TxDOT program has created a substantial market for compost, but it has been an entirely in-state market, since it is not economical to haul compost long distances. TxDOT currently is paying about $1.50 per 0.8 square meter (1 square yard) for 51 millimeters (2 inches) of erosion control compost and $1.15 per 0.8 square meter (1 square yard) for compost-manufactured topsoil. Last year, TxDOT used 356,490 cubic meters (466,000 cubic yards) of compost. Before this project started, TxDOT's purchase was 383 cubic meters (500 cubic yards) statewide. "So this has become a huge market," says McCoy.

A mulch filter sock protects inlets along I–10 near Junction, TX. Once the job is completed, the sock is split along the top, the material is left onsite, and the only waste is the sock material.

(Before) Erosion along State Highway 47 in College Station, TX, threatens this riprap slope. Left alone, the erosion would be expensive to repair.

(After) TxDOT smoothed the slope and applied erosion control compost. This photo shows the same slope 2 weeks after compost was applied.

Another economic benefit of the program was the development of a new industry—subcontractors who use truck-mounted pneumatic pumps to apply compost. Three years ago there were no contractors in Texas doing this kind of work; today, there are 12 within the State.

"This kind of application is so efficient and easy, and if you're on a steep slope it's the only way I know of to do it right," Cogburn notes. "You don't want more equipment up there creating the possibility of erosion. So it has created another niche in the industry, and I think general contractors recognize the efficiency of this method of applying compost and are willing to bid out that portion of the job to this new segment of the contracting industry."

The compost program has resulted in savings for TxDOT in several other areas. Because compost retains moisture, there is less need for watering. Successful revegetation means that construction barricades can be removed sooner, and contractors can proceed with the next phase of work or move on to other jobs. In addition, avoiding surficial slope failures and mass wasting means that maintenance dollars can be spent on future road projects rather than remediation of earlier ones.

Perhaps the most significant economic benefit of the compost project is the opportunity it provides to influence environmental decisions. Concerns about contamination of drinking water in the Bosque-Leon watershed near Waco, for example, led to a partnership between TxDOT, TCEQ, and EPA to divert cow manure to the compost program. Seven TxDOT regions agreed to buy 153,000 cubic meters (200,000 cubic yards) of compost from dairy manure composters over a 3-year period, spurred by a rebate program of $5 per 0.8 cubic meter (1 cubic yard) off the original price. This incentive was implemented not only to offset the freight cost but also was returned to the district that initiated the purchase. Cogburn says the regions will actually buy about 230,000 cubic meters (300,000 cubic yards) before the program ends next year.

Partnership Is Key

The TxDOT–TCEQ compost program has received its share of national attention. Among the awards it has earned are the 2002 President's Award (environmental category) from the American Association of State Highway and Transportation Officials and the 2002 Making a Difference Award (State quality initiative category) from the National Partnership for Highway Quality.

The U.S. Composting Council has termed the program "one of the more sophisticated and aggressive compost use and specification programs in the United States." The publicity from the awards and the numerous articles written about the program have meant that Cogburn and McCoy have found themselves fielding inquiries about compost from across the country, Canada, and Mexico.

Cogburn and McCoy view the awards and articles as ways of spreading the word about a product that can benefit highway construction projects throughout North America. But their primary focus continues to be ensuring that their agencies take full advantage of compost's benefits.

Clearly, this is already happening at TxDOT. The Vegetation Management Section of the Maintenance Division included a compost component in its revegetation training program, and the Environmental Affairs Division is including the specification of compost berms as a best management practice to provide a filter for improved water quality. In addition, the TxDOT Bridge Division is participating in research that will develop guidelines and specifications for the proper application and placement of compost filter berms.

At TCEQ, McCoy is exploring such innovations as the use of compost in new housing subdivisions. Looking back over the 7-year history of the compost project, McCoy concludes that the real secret of the project's success has been cooperation. "The partnership between TxDOT and my agency was what made this work," he says.

Timothy Barkley is a marketing and technology deployment specialist with FHWA's Resource Center in Atlanta. He has 23 years of experience and has been with FHWA for 2.5 years. He has a B.A. in advertising and design from Columbus College of the Arts.

For more information on the TxDOT erosion control program, contact Barrie Cogburn at bcogburn@dot.state.tx.us or Scott McCoy at smccoy@tceq.state.tx.us.

Glenwood Canyon

12 Years Later

by Karen Stufflebeam Rowe, Eva LaDow, and Steve Moler

More than a decade after its completion, has this marvel of highway engineering in western Colorado attained its original goals?

Nearly 12 years have passed since the Colorado Department of Transportation (CDOT) completed one of the most extraordinary highway projects ever constructed in the United States. Opened to traffic on October 14, 1992, the Glenwood Canyon project, a 20-kilometer (12.5-mile)-long network of viaducts, bridges, and tunnels constructed through an extraordinarily narrow, environmentally sensitive gorge in western Colorado, marked a milestone in the Nation's transportation history. The project not only connected the final leg of Interstate 70 (I–70), but also it symbolized the completion of the original U.S. interstate highway system.

Upon completion, the Glenwood Canyon project was revered for accomplishments in planning, context-sensitive design, work zone traffic safety and management, and construction—achieved despite numerous physical, operational, and administrative obstacles faced during construction. The project won more than 30 awards, including the 1993 Outstanding Civil Engineering Achievement Award from the American Society of Civil Engineers.

But the true measurement of a project's success comes with re-evaluation of its impact over time. Now that the highway has been in

Interstate 70 follows the Colorado River as it snakes through Glenwood Canyon, CO. *Photo: Joseph J. Kracum, Kracum Resources, LLC.*

service for more than a decade, has it lived up to its original goals of preserving the environment, improving safety, and enhancing mobility?

Analyses of traffic and crash data collected by CDOT and interviews with a variety of individuals and experts who have direct knowledge of the canyon or experience with the project reveal that the highway is in fact a great success. The overall consensus is that the project, with some exceptions, has attained—and in some cases exceeded—its original goals.

"This accomplishment is remarkable, considering the project's scope and magnitude," says Sam Caudill, a longtime local environmentalist who once opposed the project and later chaired the project's citizens advisory committee. "The Glenwood Canyon project continues today to serve as a model for what can be accomplished in the areas of environmental stewardship, safety improvements, and congestion mitigation despite difficult challenges."

Saving the Best for Last

Even as early as 1887 when a railroad track was constructed through the region, the Glenwood Canyon corridor served as a vital link in the Nation's surface transportation network. A primitive dirt road was built next in the early 1900s, and this canyon road was upgraded to a two-lane paved highway, designated U.S. 6, in the 1930s. U.S. 6 became the primary highway link between Denver and States to the west for the next six decades.

But as automobile traffic increased in the 1960s and 1970s, U.S. 6 through Glenwood Canyon became one of the most dangerous stretches of highway in Colorado, accumulating crash and fatality rates higher than those of similar highways. The 915-meter (3,000-foot)-deep canyon, carved by the powerful currents of the Colorado River more than 70 million years ago, stood as a natural barrier that delayed upgrading this final section of I–70 (U.S. 6) to a wider, safer interstate highway.

The challenge was how to squeeze a modern, four-lane freeway into a gorge barely wide enough to accommodate the existing two-lane highway without significantly damaging the environment. CDOT's answer was to construct two roadways, one nearly on top of the other. The final design consisted of a predominately elevated roadway including 40 bridges and viaducts stretching more than 9.5 kilometers (6 miles) between sections of roadway. The highway also has 24 kilometers (15 miles) of retaining walls and a 1,200-meter (4,000-foot)-long tunnel with bores for traffic in both directions. The retaining walls are secured with ground-anchored tiebacks and soil anchors, and the highway is paved with cast-in-place, post-tensioned pavement slabs cantilevered 1.8 meters (6 feet) beyond the retaining walls.

In addition to a facility for traffic management and maintenance inside the tunnel, the corridor also houses four full-service rest areas, a bicycle path running the canyon's entire length, and special facilities for launching rafts, boats, and kayaks.

Today, the Glenwood Canyon project is a model of environmental preservation, safety, and mobility, thanks in large part to good planning. Direct public involvement during the early stages of planning and design in the 1970s by a citizen's advisory committee and a technical review group led to many sound decisions that have enabled the canyon to flourish.

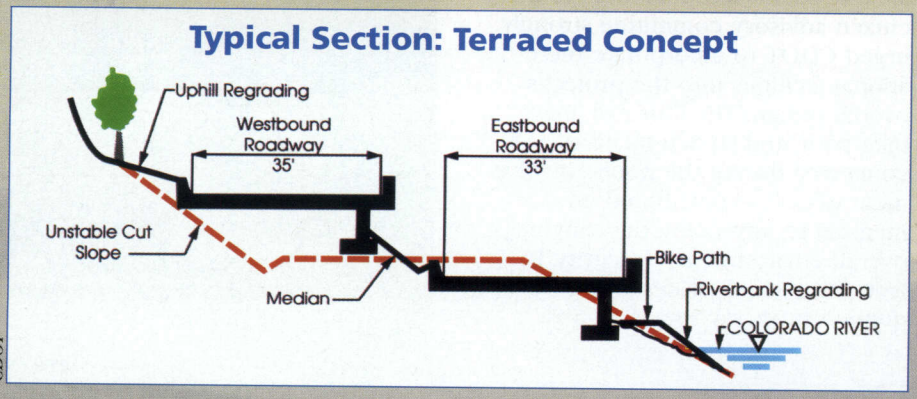
Glenwood Motor Club

The first highway through Glenwood Canyon was a primitive dirt road, shown here in 1903.

Enhancing Recreation

The old two-lane highway, though it served the public well for more than 60 years, had many drawbacks. The absence of recreational infrastructure like formal rest areas, picnic grounds, and trailheads created an almost chaotic situation. Motorists turned off the highway at the many informal pullouts to fish, picnic, or camp, leaving garbage, ash-filled fire rings, and other debris within just a few feet of the river. The highway's extremely narrow or nonexistent shoulders made walking or cycling along the roadway unsafe. Anglers, rafters, and kayakers had to climb down steep rock embankments to reach the water.

During the planning and public involvement process in the 1970s,



CDOT

This diagram illustrates the terraced system used for the Glenwood Canyon project. With steep slopes above and below the highway, a terraced design, in which a post-tensioned concrete slab cantilevers out over the top of the retaining wall, was used to allow eastbound and westbound lanes of I–70 to be built closer together.

CDOT

The old two-lane U.S. 6, shown in this 1969 CDOT photo, served as a vital transportation link for six decades. But increased traffic, combined with poor roadway geometrics, prompted the need for completion of the interstate through Glenwood Canyon.

local residents and members of the citizen advisory committee strongly urged CDOT to incorporate recreational facilities into the project's overall design. The four rest areas, bike path, and launch facilities—all conceived during the public involvement period—contributed immensely to improving the canyon's overall environmental integrity. In fact, many local residents and frequent visitors say the canyon is

Joseph J. Kracum, Kracum Resources, LLC

A bicycle and pedestrian path running the entire length of the canyon has opened up new recreational opportunities not possible during the days of the old two-lane highway.

Joseph J. Kracum, Kracum Resources, LLC

Rafters and kayakers, like this one, now have safe and convenient access to the river, thanks to launch and pickup ramps incorporated into the project.

Joseph J. Kracum, Kracum Resources, LLC

The Grizzly Creek Rest Area is one of four formal rest areas that replaced the old highway's informal pullouts. The new facility provides more environmentally friendly access to the canyon while leaving other, more sensitive areas untouched.

actually safer, cleaner, and more accessible than it was before the highway was upgraded to an interstate.

"I do think the project has minimized environmental impacts," says Steve Smith, a local environmentalist. "I actually think the canyon is better than it was before because the new project repaired environmental damage caused by road construction in earlier eras."

Jeanne Golay, a former Olympic and professional cyclist who lives in Glenwood Springs, says the canyon prior to construction was a "forbidden zone" for cyclists because of the old highway's narrow shoulders. Cyclists who wanted to go west from Vail Pass had to be picked up and driven by automobile through the canyon.

"The Glenwood Canyon project is really huge from a cycling standpoint," Golay says. "The bike trail has opened up a whole new world to cyclists. Cyclists going west now have an option. I think overall the project has been nothing but positive."

The four full-service rest areas, which replaced the old highway's numerous informal pullouts, have proven invaluable from an environmental and recreational standpoint. All of the rest areas have formal parking areas, restrooms, interpretive displays, picnic grounds, water fountains, trash receptacles, and access to hiking trails. To accommodate increased demand, the restrooms at the Grizzly Creek Rest Area were upgraded recently from a composting system to a new, more environmentally friendly textile-packed bed filter system that uses an ultraviolet disinfection process to treat restroom sewage. The new system has considerably higher capacity and is more adaptable to steep terrain. Similar upgrades are planned for two of the canyon's other rest areas in anticipation of a 50 percent increase in corridor traffic by 2015.

Rafters and kayakers are delighted with the Glenwood Canyon project because CDOT constructed safe and convenient launch and pickup facilities along the river at popular whitewater sections. "We used to have to climb down 30

feet [9 meters] of rocks with our rafts to get to the river," says Ken Larson of Whitewater Rafting in Glenwood Springs. "Now we have ramps and designated access, which are a whole lot better than what we had before."

Another reason for improved whitewater activities is that roadway construction in several areas slightly narrowed the river. "I think the highway construction may have helped us," Larson says. "In several places the rapids are faster than before. The kayakers and rafters actually like the river even more now."

Fishing also has improved since the days of the two-lane highway, according to Drew Reid, a longtime local fishing guide with Roaring Fork Anglers of Glenwood Springs. Though the overall fish population appears to have stayed about the same, rock embankments constructed along these narrower sections have provided new and enhanced trout habitat.

"I have to say, they kept the river in good shape during construction," Reid says, "and it remains a nice place to fish today."

Environmental Safeguards

Although recreational conditions and opportunities clearly have improved, the impacts on plants and wildlife are less clear. Because no formal studies were conducted before or after construction, officials cannot determine precisely how the project affected the canyon's ecosystem. But several

A Tunnel with Vision

"Located roughly at the midpoint of Glenwood Canyon is one of the most technologically advanced tunnel systems in the country," says Ron Speral, a program delivery engineer in FHWA's Colorado Division who worked as an operations engineer during the tunnel's construction. The 1,200-meter (4,000-foot)-long Hanging Lake Tunnel is a major reason for the improved safety of travel through the canyon since construction of I–70.

A first-of-its-kind traffic control and information center constructed deep inside the tunnel is equipped with an incident detection and traffic management system designed to track each vehicle through the tunnel using a system of sensors and closed-circuit television cameras.

A fleet of tow trucks, fire trucks, and other emergency vehicles stationed in a large garage in the middle of the tunnel are prepared, 24 hours a day, to remove vehicles from the tunnel and the entire canyon corridor when necessary. A lane-control system and variable message signs enable tunnel operators to employ and communicate closures of individual lanes or tunnel bores. In the event of a major incident, the system can provide advisories and even evacuation directions to motorists through an FM emergency broadcast radio system that automatically overrides a vehicle's radio inside the tunnel, regardless of the station the driver is listening to.

Over the past 12 years, CDOT has expanded and improved the technology to enhance mobility and improve safety. In 1996, for example, CDOT installed a variable message sign at the approach to one of the canyon's sharper, more crash-prone curves. The Smart Sign, as it is called, uses radar to detect a vehicle's speed and then prominently displays a message in flashing bold red letters: "YOUR SPEED IS 60 mph." Immediately after the first message, a second one follows, warning: "45 mph CURVE AHEAD." Since the sign was installed, average vehicle speeds at the curve decreased from 106 km/h (66 mph) to 98 km/h (61 mph), and even more significantly, average truck speeds went down to 77 km/h (48 mph), according to CDOT data.

In addition, CDOT upgraded the original emergency callbox system from radio-controlled to a cellular phone callbox and computerized answering system. The agency also placed callboxes about every 0.8 kilometer (0.5 mile) throughout the canyon and in several high-incident areas.

Joseph J. Kracum, Kracum Resources, LLC

A CDOT employee in the Hanging Lake Traffic Control Center keeps a watchful eye on the tunnel and its approaches using recently upgraded computers and other equipment. Hanging Lake also is the traffic control center for western and southern Colorado, including the future Wolf Creek Pass Tunnel.

local environmentalists and wildlife experts familiar with the canyon suggest that the impacts are minimal.

"The tree and plant preservation program in Glenwood Canyon is one of the project's top accomplishments," says Smith. Prior to construction, workers marked and fenced off important trees and other vegetation. In places where heavy equipment would be used, trees and plants were trimmed to the ground but not removed. "After construction, the vegetation grew back thicker and healthier than before," he says.

In areas where heavy impacts were unavoidable, a massive revegetation program involving the seeding and replanting of more than 150,000 native plants helped bring the canyon back to its original condition after construction. Exposed rock cuts were stained to match their original colors, and the construction of bridges and viaducts above heavy growth areas helped minimize plant removal and damage.

"Glenwood Canyon is a model for how to minimize damage to the environment," Smith says. "The landscaping and revegetation programs are examples of how to bring back the natural look. The careful placement of pillars and columns made it possible to leave trees and vegetation in place during construction and after. It may have cost more, but it's been worth it."

Caudill adds, "When I drive through the canyon now, I definitely think the project has increased the canyon's

The Hanging Lake Traffic Control Center, located above the emergency vehicle garage in the middle of the tunnels, also received a much-needed upgrade. The technology in the control center, including camera monitors, computer consoles, and other high-tech systems for managing traffic, had become obsolete. Much of the hardware was no longer manufactured, making service difficult and replacement parts hard to find. As a result, CDOT has nearly completed a major $1.5 million redesign and upgrade of the computer and traffic-control systems that have kept the Hanging Lake Tunnel perhaps the most technologically advanced in the country.

Under the old system, all of the tunnel's safety functions—variable message signs, highway advisory radio, emergency callboxes, and closed-circuit television cameras—worked independently. The new PC-based system brings all of the tunnel's safety functions into a single, integrated program, providing CDOT with the latest in low-cost, high-performance microprocessor technology and programmable logic controllers. The new system is designed to make future upgrades easier and will provide the technology to enable CDOT to connect the control center to other State facilities.

After the upgrade is complete, the tunnel system will have a vehicle detection system involving a state-of-the-art computer that predicts a vehicle's arrival in each of the tunnel's 16 traffic-control zones. Failure of a vehicle to reach the next zone triggers an alarm, enabling the tunnel staff to respond more quickly to a stopped vehicle in the tunnel.

The Hanging Lake Traffic Control Center now controls 82 variable message signs installed throughout western and southern Colorado, and more signs are being added. Also, Hanging Lake Tunnel soon will become the control center for a new tunnel that is under construction at Wolf Creek Pass in southwestern Colorado on U.S. 160. Staff from Hanging Lake will monitor the new tunnel's traffic video images and other systems and functions such as fans and weather sensors. Although more than 320 kilometers (200 miles) apart, the two tunnels will function harmoniously, making better use of the State's resources.

All of these tunnel upgrades are making Glenwood Canyon and other highways in western and southern Colorado safer and more efficient.

Joseph J. Kracum, Kracum Resources, LLC

A garage deep inside the tunnel houses a fleet of emergency vehicles that responds 24 hours a day to keep the tunnel safe and operating smoothly.

Joseph J. Kracum, Kracum Resources, LLC

The Hanging Lake Rest Area is another one of the four formal rest areas.

overall beauty, particularly the vegetation. It makes me feel great to see how well the canyon turned out. I've never heard anything negative about the project from anyone in the area."

Wildlife Issues

The final question from an environmental perspective is, How is the wildlife faring? Glenwood Canyon is bordered on both sides by the White River National Forest, where herds of elk, deer, bighorn sheep, and other species make their homes. Planners and designers concluded that a predominantly elevated roadway would give the wildlife ample opportunities to move freely across and through the canyon with minimal conflicts with traffic.

Although no formal wildlife studies were conducted in the canyon either before or after construction, two local biologists suggest that the effects of the upgraded interstate on wildlife are minimal if any. Based on personal observations, Bill Heicher, retired district wildlife manager with the Colorado Division of Wildlife, and Larry Green, who worked as a district wildlife manager for the division from 1971 to 1999 and served on the project's Technical Review Group, agree that construction of the interstate has not affected local wildlife adversely.

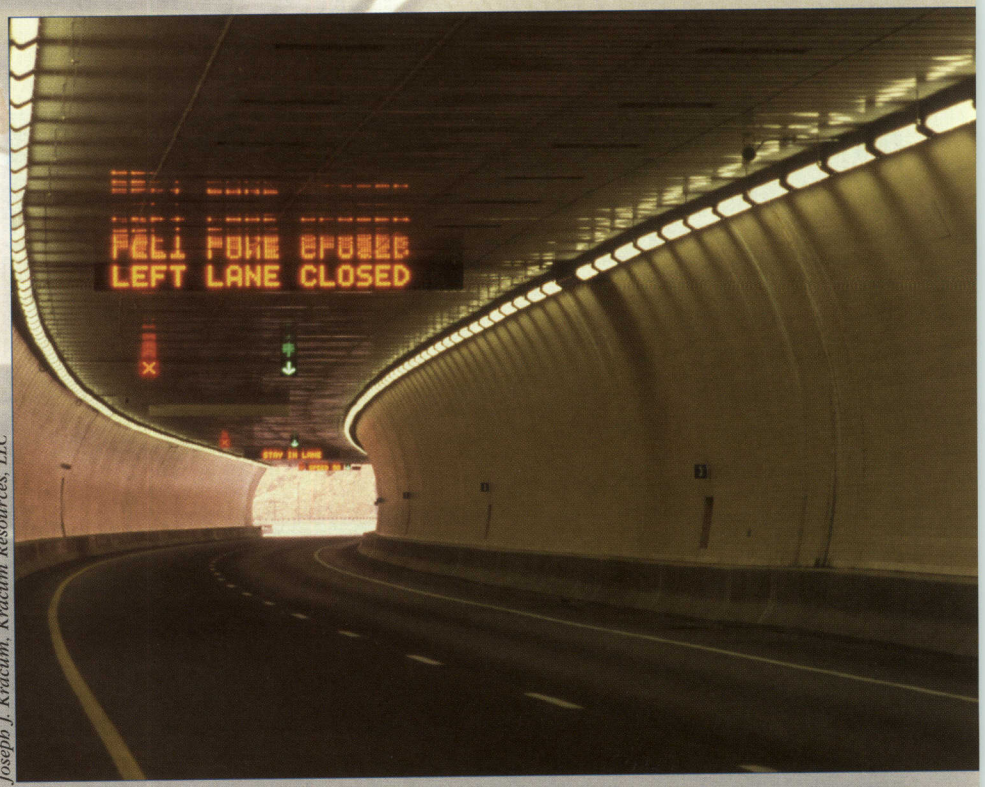
Is Glenwood Canyon Safer?

Numerous traffic studies show that when a State upgrades a road from two lanes to a four-lane divided highway, overall safety typically improves. This improvement is clearly the case with Glenwood Canyon, according to CDOT crash data.

Driving Glenwood Canyon before it was upgraded to an interstate was an experience in contrasts and sudden changes. Motorists would travel around 105 kilometers per hour (65 miles per hour) on the already-completed interstate sections, but upon arrival at the canyon, they would have to slow down abruptly to around 73 km/h (45 mph) to negotiate the much narrower, winding two-lane roadway. The old highway offered little or no room for driver error—a motorist could easily veer into oncoming traffic or off the road and into the Colorado River.

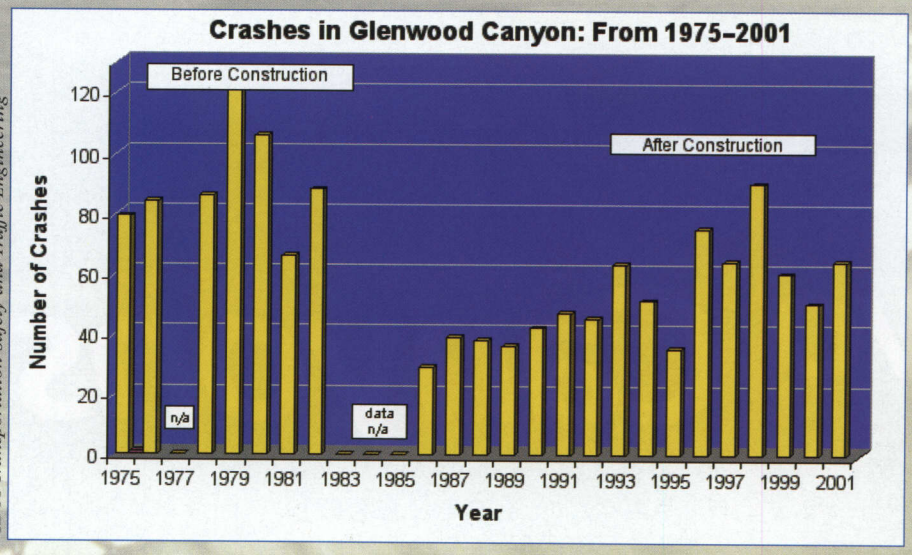
The sudden alteration of driver expectations of roadway conditions, combined with heavy traffic and poor roadway geometrics, led to the canyon's status as one of the most dangerous stretches of two-lane highway in the State. By 1979, the year before construction began, the number of annual crashes had reached an all-time high of 121 incidents, 25 of those involving injuries. This was a significant increase from the 86 crashes in 1978, 84 crashes in 1976, and 79 crashes in 1975. (CDOT crash data are unavailable for 1977.)

Since the route through Glenwood Canyon was upgraded to an interstate, the number of annual crashes dropped nearly 40 percent, despite significant increases in traffic vol-



Joseph J. Kracum, Kracum Resources, LLC

One of Hanging Lake Tunnel's many safety features is variable message signs like this one that alerts drivers of a lane closure.



CDOT Transportation Safety and Traffic Engineering

Despite steady increases in traffic volume, the number of crashes in Glenwood Canyon has dropped by nearly 40 percent since the highway was upgraded to an interstate in 1992.

ume. In the 5 years prior to construction, 1975–1980 (excluding 1977), the average number of annual crashes was 106. Over the most recent 5-year period for which statistics are available, 1997–2001, the average number of annual crashes dropped to 67. This reduction is significant, considering that average daily traffic has more than doubled since the start of construction.

Other data support Glenwood Canyon's improved safety. In May 2003, the National Highway Traffic Safety Administration's Fatality Analysis Reporting System showed that the national fatality rate on rural interstates in 2002 was 1.18 per 100 million vehicle miles traveled (VMT). For the section of I–70 through Glenwood Canyon between mileposts 118–130 the rate was 0.75 from 1992–2001.

Maintenance Challenges

Keeping Glenwood Canyon safe is an ongoing challenge for CDOT, particularly during the winter. Because many stretches of the highway remain shady for long periods during winter due to the steep terrain and elevated structures, CDOT takes extra maintenance precautions to prevent the roadway from becoming dangerously snow-packed and icy.

CDOT, with help from FHWA, tested new deicing equipment and snow-removal techniques during a 3-year study in the mid-1990s at the western end of the canyon. The results helped CDOT develop a successful program involving installation of an ice-detection system throughout the canyon. The system provides weather-related information that road managers can use to predict precise times when chemical deicing would work most effectively. As a result, winter driving conditions have improved significantly, according to CDOT studies and crash data from the State police. In addition to fewer snow-related crashes, less salt and sand now accumulate in the river, on roadside vegetation, and along the bicycle path.

To minimize potential traffic and safety problems related to the climate and future maintenance activities, CDOT completed an asphalt overlay in 2001 using a high-performance asphalt designed to be capable of withstanding the canyon's extreme weather and heavy traffic. The specially designed pavement combines asphalt transported from a lake on the island of Trinidad in the Caribbean, with steel slag aggregate, a byproduct from a steel manufacturing plant in Pueblo, CO.

Keeping Traffic Moving

Upgrading Glenwood Canyon to an interstate could not have come at a better time from the perspective of traffic congestion. As a two-lane highway, the canyon route often caused traffic to slow to a crawl during peak periods or come to a complete standstill after a crash. Congestion began to worsen noticeably during the 1970s when traffic volume nearly doubled from an average of 3,301 vehicles per day in 1970 to 6,026 in 1979. The 1980s, when most of the project was built, brought another significant jump in traffic volume, from an average of 6,586 vehicles per day in 1980 to 9,168 vehicles per day in 1989. By the time the project was completed in 1992, average daily traffic had climbed to 10,762. With Glenwood Canyon now a four-lane interstate, traffic flows through the corridor with few interruptions, despite average daily traffic now approaching 17,000 vehicles per day.

According to CDOT officials, if Glenwood Canyon had remained a two-lane highway, many motorists would have chosen an alternate route in the daytime or traveled at night to avoid lengthy delays. It would have been nearly impossible for emergency equipment to respond to incidents in the canyon if the old two-lane facility had to serve the 16,500-plus vehicles that currently pass through the canyon every day.

After almost 12 years of service, the I–70 Glenwood Canyon project not only has delivered as promised but remains one of the crown jewels of the interstate highway system.

Karen Stufflebeam Rowe is a CDOT resident engineer for Colorado's Region 3, which includes Glenwood Canyon.

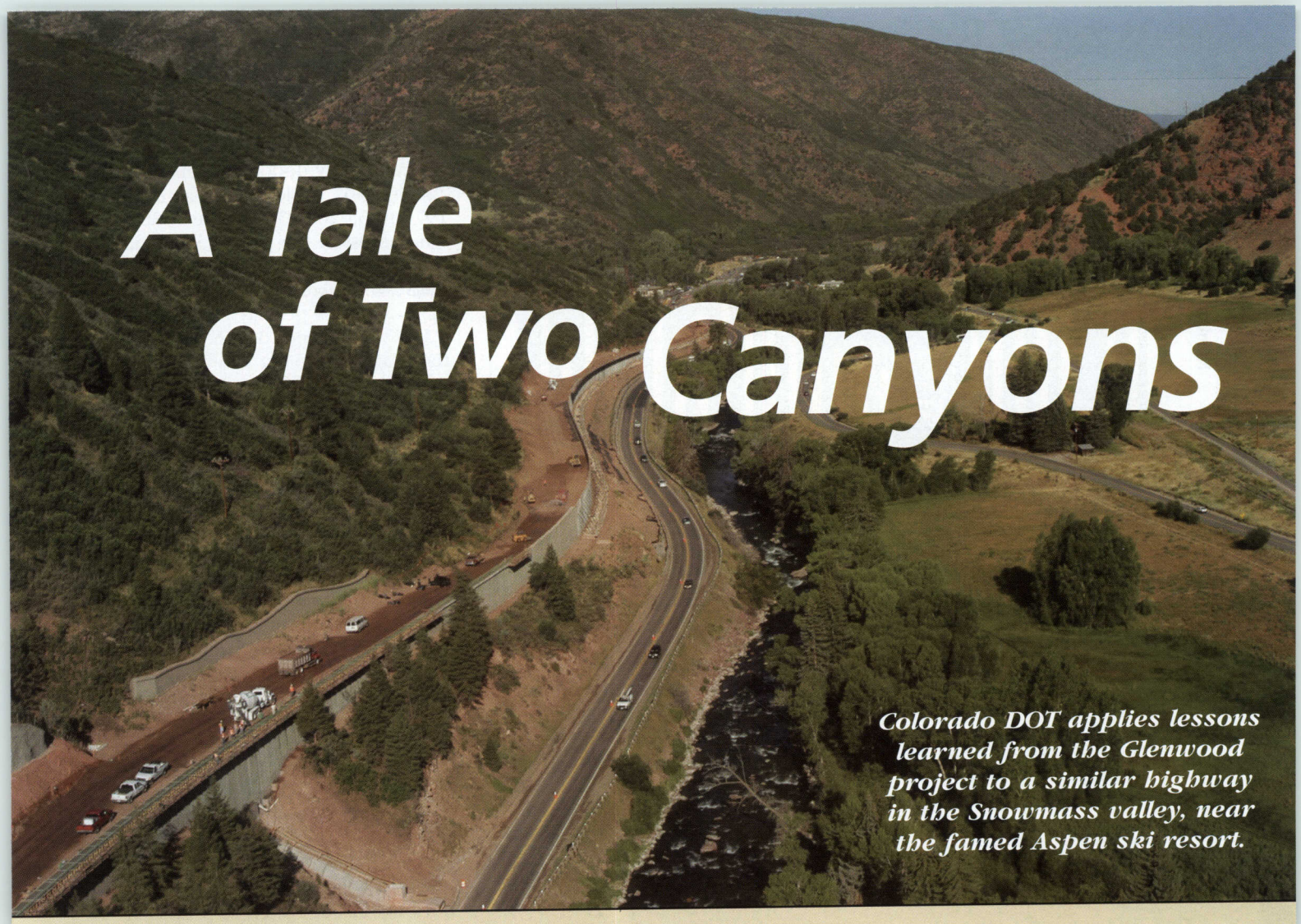
Eva LaDow, P.E., is a field operations engineer in FHWA's Colorado Division.

Steve Moler is a public affairs specialist at FHWA's Resource Center in San Francisco.

Tom Metheny of CDOT also contributed to the article, and **Glen Fromm** of Parsons Brinckerhoff contributed to the sidebar, "A Tunnel with Vision."

For more information about the Glenwood Canyon project, contact Steve Moler at 415-744-3103 or steve.moler@fhwa.dot.gov.

A Tale of Two Canyons



Colorado DOT applies lessons learned from the Glenwood project to a similar highway in the Snowmass valley, near the famed Aspen ski resort.

by Steve Moler

The Colorado Department of Transportation (CDOT) knows a thing or two about building highways through complex terrain. In 1992, CDOT completed an award-winning project that extended I–70 through Glenwood Canyon, finishing the last section of an interstate that stretches from Baltimore, MD, to Cove Fort, UT. The project later received the 1993 Outstanding Civil Engineering Achievement Award from the American Society of Civil Engineers and is considered one of the greatest highway engineering accomplishments in U.S. transportation history. (See "Glenwood Canyon 12 Years Later" on page 16.)

Not one to rest on its laurels, shortly after finishing Glenwood Canyon the CDOT began planning a project in Snowmass Canyon 56 kilometers (35 miles) away. The Glenwood and Snowmass projects are remarkably similar. Both involve upgrading overburdened two-lane highways to four lanes through extremely narrow, ecologically sensitive canyons to improve safety and mobility while minimizing environmental impacts. "Both required exceptional planning, the latest in context-sensitive design, and construction ingenuity," says Ralph Trapani, the CDOT project manager on the Glenwood Canyon project, now a private consultant.

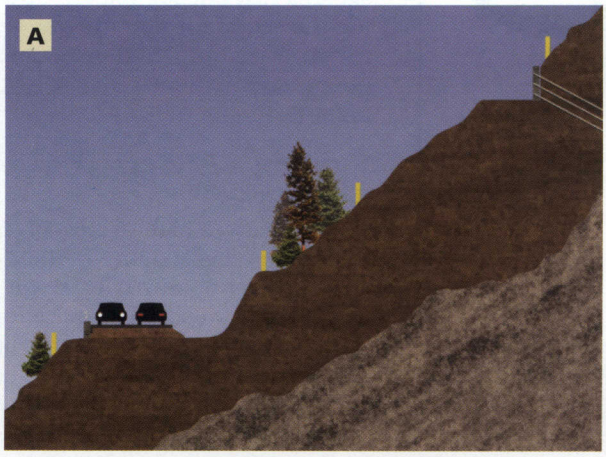
The project in Snowmass Canyon, which began in September 2000, applies the lessons that CDOT learned in Glenwood to upgrade a section of highway northwest of the ski resort town of Aspen. The $100 million project consists of widening 5.6 kilometers (3.5 miles) of State Highway (S.H.) 82 through Snowmass Canyon, a narrow valley carved by the Roaring Fork River. Like Glenwood Canyon, the Snowmass Canyon project involves building two roadways—one virtually on top of the other—along steep, geologically unstable slopes using a terraced system of retaining walls and bridges to minimize environmental impacts.

(Above) While the up-valley lanes took shape in Snowmass Canyon during the summer of 2003, the old two-lane highway to the right carried traffic one way up the valley. The two-lane county road across the river to the right carried westbound traffic down the valley. *Photo: Joseph J. Kracum, Kracum Resources, LLC.*

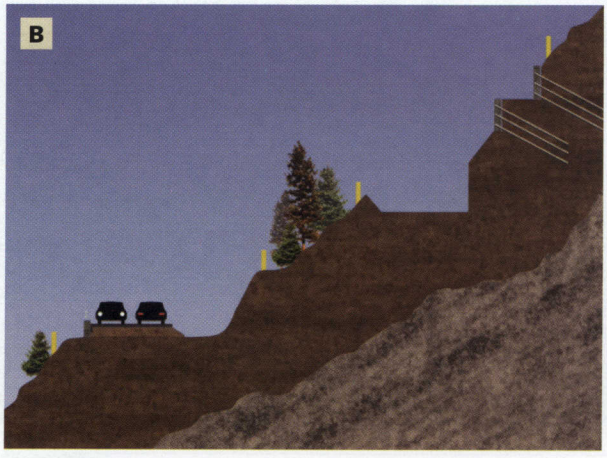
Saving the Hardest for Last

Snowmass Canyon represents the final section of roadway in a three-decade-long project to upgrade S.H. 82 from two to four lanes between Glenwood Springs and the Aspen area. As with Glenwood Canyon, which was the final segment of I–70

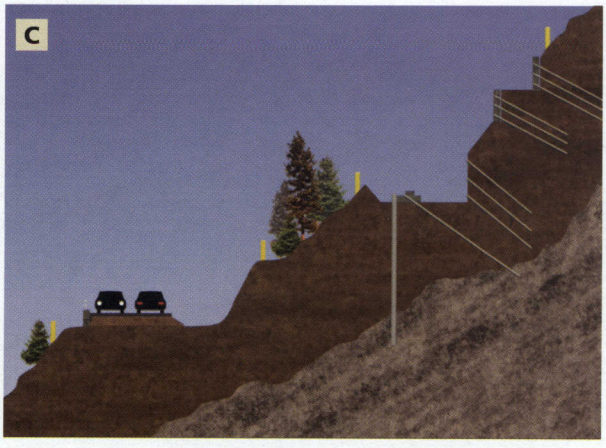
Cross-Sectional View of the Snowmass Canyon Project



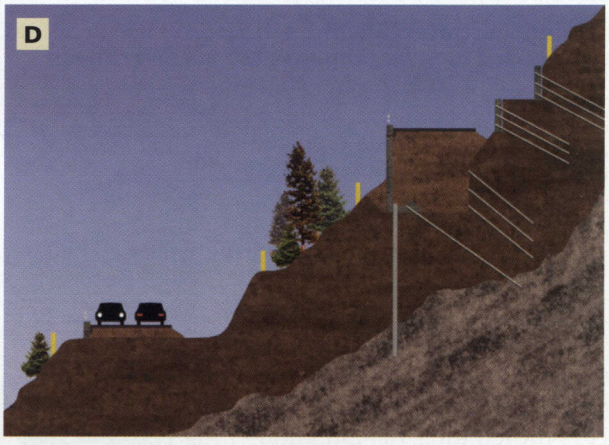
A. After workers install fences (yellow poles) to preserve the environment, construction begins with vertical cuts into the hillside (upper right) for the up-valley lanes. Soil-nail walls using corrosion-proof steel bars are installed to stabilize the slope. Then the construction crew members install reinforced steel and anchor plates and spray shotcrete onto the vertical surface to complete the reinforced system.



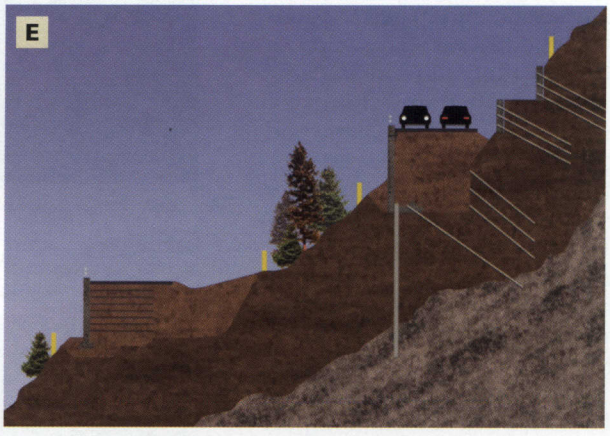
B. The process is repeated as the crew installs a second set of retaining walls into the hillside. Mass excavation is necessary to reach the bottom of the footing elevation for the walls that support the roadway.



C. Shafts are drilled vertically into the bedrock and filled with reinforced concrete. The workers then construct a reinforced concrete footing at the top of the shaft and drill through the footing to the bedrock to place the tieback ground anchor. This system of compression and tension handles the extreme forces that act on the earth retaining system.

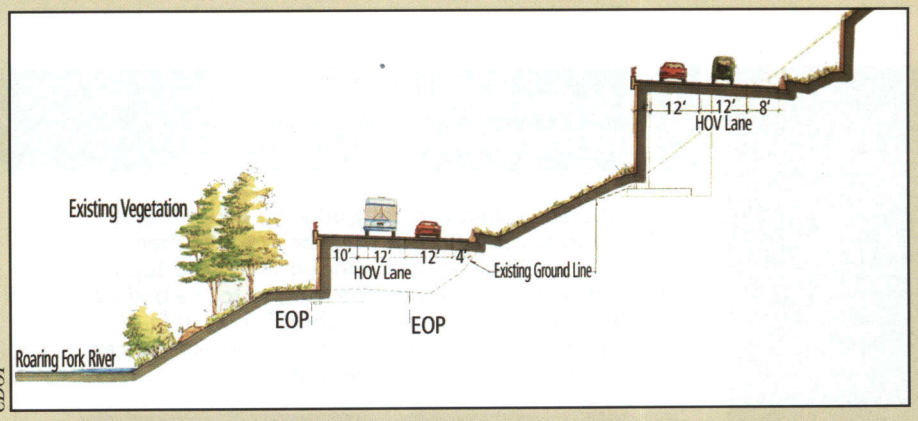


D. An architecturally finished precast panel is placed vertically on the footing. Reinforcing, structural backfill and embankment then are placed on top. Pavement, traffic signs, concrete barriers, guard-rails, and striping complete the up-valley lanes.



E. Construction on the down-valley lanes begins with excavation for the retaining wall foundations (lower left). The crew places the precast wall panel vertically on the footing, and reinforcement grids are attached to the panel. Structural backfill material placed and compacted in lifts helps form the mechanically stabilized earth wall, and embankment material is placed next. Finally, pavement, traffic signs, concrete barriers, guardrails, and striping are added to complete the down-valley lanes.

To view an animated slideshow of this cross-sectional sequence, visit www.sh82.com /snowmasscanyon.html.



CDOT

This drawing illustrates how the terraced system enables CDOT to construct a four-lane divided highway through the narrow canyon.

to be completed, the Snowmass Canyon section of the S.H. 82 upgrade was saved for last because it encompassed the route's most difficult environmental, engineering, and financial challenges.

On October 14, 1992, the day CDOT cut the ribbon opening the Glenwood Canyon project, many of the project's planners, designers, and engineers turned their full attention to the difficult section of S.H. 82 between Basalt and Aspen, which contains the Snowmass Canyon segment. This 27-kilometer (17-mile) stretch of highway through some of the most scenic and majestic countryside in the United States had become one of Colorado's most dangerous two-lane highways for many of the same reasons that Glenwood Canyon attained a similar status a decade earlier. Undercapacity, high traffic volumes, sharp curves, narrow lanes and shoulder widths, lack of acceleration and deceleration lanes, and inadequate sight distances for passing eventually earned S.H. 82 the grim nickname "Killer 82."

By late 1992, CDOT had published a draft environmental impact statement for the section starting just east of Basalt and ending near Aspen. But CDOT and the Federal Highway Administration (FHWA) ultimately published a final environmental impact statement in October 1993 that covered the section from just east of Basalt to the Buttermilk ski area just outside Aspen. Upgrading the section inside the town of Aspen was considered in a subsequent environmental impact statement for the entrance to Aspen.

Finding a Preferred Alternative

The primary debate over roadway alignments focused on whether to construct a one-way couplet for down-valley westbound traffic on the side of Roaring Fork River opposite the existing S.H. 82 through Snowmass Canyon. The new alignment would roughly parallel an

Before (top) and after (bottom) renderings illustrate how CDOT is constructing a four-lane divided highway through the narrowest possible footprint to minimize environmental impacts. *Photos: CDOT.*

Snowmass Video Facilitates Technology Transfer

"The construction of I–70 through Glenwood Canyon, CO, is a marvel of innovation in highway design and construction," says Ron Speral, a program delivery engineer in FHWA's Colorado Division who served as an operations engineer during the Glenwood project. A series of videos highlighting the project's numerous planning, design, environmental, and construction innovations brought these achievements home to many in the profession of civil engineering.

Joe Elsen, the CDOT manager for the Snowmass Canyon project, previously worked as an engineer on Glenwood Canyon. Elsen's experience with the videos of the Glenwood project provided the impetus to film the construction in Snowmass Canyon. The video enables the Snowmass team to share with a wider audience the technological innovations used to reconstruct the section of S.H. 82 near Aspen.

"Being involved with the videos," Elsen says, "and knowing how often requests came in for them made me realize just how effective this medium is for transferring technology."

Elsen describes video as the ideal medium for encapsulating the technology because it not only appeals to a broad audience of decisionmakers who need the information, but it also helps viewers visualize the technologies and their applications. Elsen imagines an engineer watching the video and thinking: "There's our solution. Why reinvent the wheel?"

Steve Moler

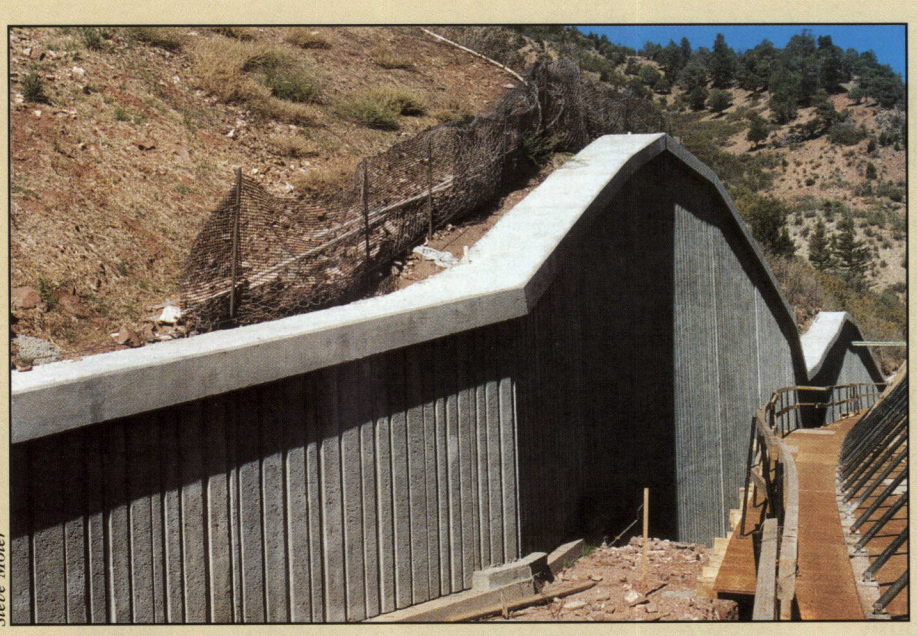
A precast concrete panel with attached geogrid forms one of the project's mechanically stabilized earth walls.

The 25-minute video focuses on how CDOT and its consultants and contractors are using innovative construction techniques to overcome the challenges of building a four-lane divided highway through a narrow, environmentally sensitive corridor. Among the techniques featured are mechanically stabilized earth walls that combine precast panels with geogrids and recycled structural backfill that combines alluvial and colluvial soils to avoid waste. Other technologies include precast, post-tensioned double-T walls, tieback and soil-nail walls, micropiles for shoring precast L-walls, and geotechnical instrumentation that ties all the systems together.

Viewers will see how the geotechnical designer employed innovative analysis techniques, how the contractors planned their operations given limited access, and how they handled value-engineering change proposals, an administrative process that allows a contractor to bring innovative ideas and solutions to the project beyond what was originally contracted.

Produced by a company in Glenwood Springs, CO, the video is offered in both VHS and DVD formats and serves as a learning tool and historical record of the project's achievements.

For more information about the Snowmass Canyon project or video, contact Joe Elsen at joseph.elsen@dot.state.co.us.



Steve Moler

A precast architectural panel covers a soil-nail wall.

existing railroad right-of-way. The up-valley eastbound traffic would use the old S.H. 82 roadway. Although this alternative would have saved millions in project costs, CDOT eventually rejected it because of the adverse impacts on wildlife and property owners along the proposed right-of-way.

As the preferred alternative, CDOT and FHWA selected an alignment slightly higher up the canyon slopes from the existing highway, because it would have the least environmental and social impacts. The chosen alternative forced planners and designers to face the same predicament they had experienced with Glenwood Canyon: how to cram four lanes of roadway into an extremely narrow footprint, bordered by a river on one side and steep canyon slopes on another, without harming the environment.

"The solution was challenging," says Joe Elsen, CDOT's manager for the Snowmass Canyon project. "We were fortunate to be able to apply our knowledge and experience from Glenwood to the Snowmass Canyon site."

During the drafting of the environmental impact statement, local county officials and the public wanted to evaluate transit options in addition to the four-lane highway. Five intermodal alternatives were developed, including a no-build option that served primarily as a baseline for evaluating the other alternatives. The preferred alternative provides for bus and high-occupancy vehicle lanes in some sections, bus park-and-ride facilities, a multimodal transfer station at the Buttermilk ski area, and a future commuter rail corridor that currently is under study.

Geotechnical Complexities

Although Glenwood Canyon is almost four times longer, Snowmass Canyon arguably is more complicated, at least from a geotechnical standpoint. After more than 2 years of geotechnical studies and analysis, CDOT decided to construct more elaborate and complex soil-nail, tieback, and double-T walls using various types of post-tensioned ground anchors embedded in the bedrock to stabilize the hillsides. The department is building these earth retaining systems—some as long as 1,200 meters (4,000 feet)—on both the up-valley and down-valley lanes. In all, the project includes 6 bridges and some 42 earth retaining systems.

"Anything that's considered state-of-the art from a geotechnical standpoint we're doing on this project," says CDOT project engineer Pete Mertes. "We have a great team of experts making this project a success."

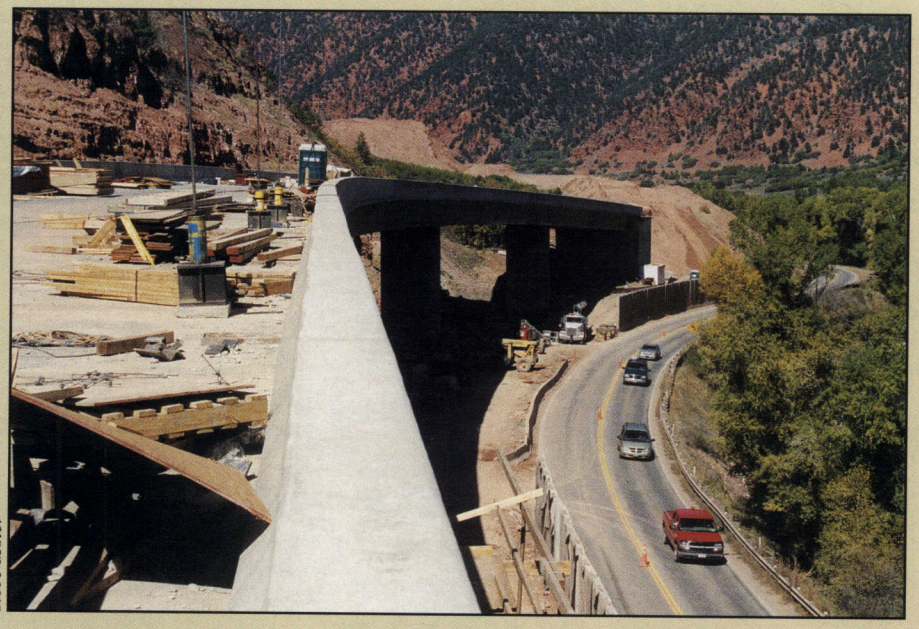
Environmental Protection

The project's strategies to protect the environment rival—and in some cases exceed—those employed in Glenwood Canyon. "CDOT has gone to great lengths to align the new highway based on established deer and elk migration routes," says Elsen.

Two of the project's six bridges are designed strictly as game cross-

Steve Moler

A double-T retaining wall takes shape in September 2002 at the approach to Bridge No. 2, one of the project's two 290-meter (950-foot) bridges.



Steve Moler

Bridge No. 2 is shown under construction in September 2002. Traffic passes by the new bridge traveling on the old S.H. 82 on the right.

ings, allowing deer and elk to pass underneath the highway at ground level. An elaborate management system for storm water and a plan for controlling erosion are among the many measures CDOT is employing to help maintain the integrity and health of the Roaring Fork River and preserve its riparian zones.

"In Glenwood Canyon, the reconstruction required that we fix the banks of the Colorado River that were denuded or constructed hastily using rip-and-tear techniques," Elsen says. "But with Snowmass, we were able to avoid touching the Roaring Fork River."

Tree preservation is a major component of environmental preservation, as it was in Glenwood Canyon. CDOT designed much of the up-valley alignment to avoid as many stands of larger, more mature trees as possible. The space between the up-valley and down-valley lanes stands as an environmental island of untouched trees and vegetation. Disturbed areas will be replanted with native vegetation to return the canyon to its original condition.

With respect to recreation, CDOT took a page out of Glenwood Canyon's playbook, providing bicyclists with 2.5-meter (8-foot)-wide shoulders along the roadway for safe cycling. CDOT also created pedestrian access to the river at various points.

Traffic Mitigation

One advantage at Snowmass Canyon that CDOT did not enjoy in Glenwood was access to an alternate route to detour traffic during construction. In Glenwood, traffic had to be stopped for 30 minutes on average to allow construction crews to work because there was simply nowhere to divert traffic.

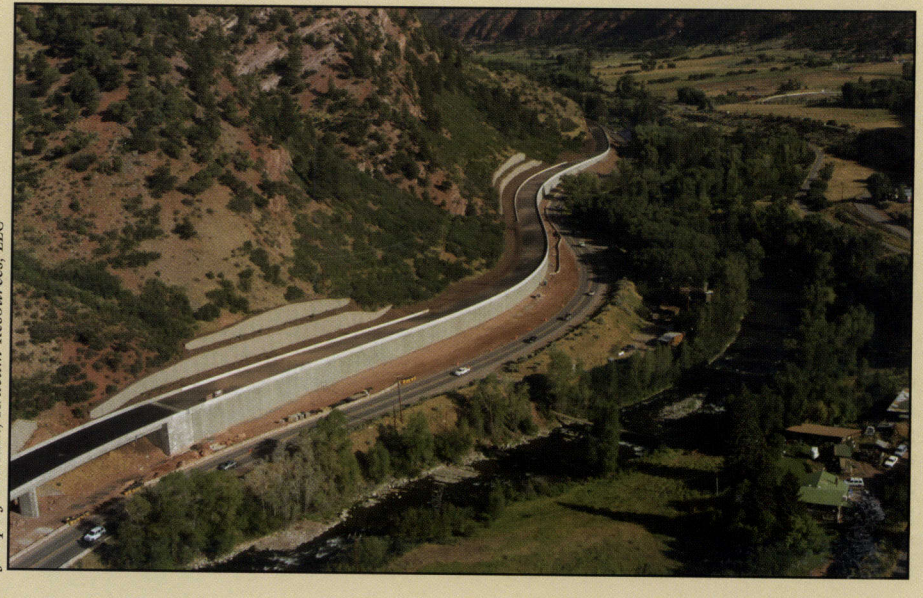
In Snowmass Canyon, during construction of the up-valley lanes (those at higher elevations), CDOT could divert one lane of traffic from S.H. 82 onto a county road located on the other side of the Roaring Fork River. Traffic going in the opposite direction could use one lane of S.H. 82. This arrangement not only reduced the number and length of traffic delays but also gave construction crews more room and flexibility to work.

With the up-valley lanes now complete and handling all two-way traffic, the detour is no longer necessary. Construction of the down-valley lanes is in full swing. When CDOT completes the project as early as fall 2004, 1 year ahead of the original contract completion date, perhaps the improvements in Snowmass Canyon will lead motorists to consider changing the highway's nickname from "Killer 82" to "Son of Glenwood Canyon."

Steve Moler is the public affairs specialist at FHWA's Resource Center office in San Francisco.

Susanna Hughes Reck, the technology deployment specialist at FHWA's Lakewood, CO, satellite office of the Resource Center office in San Francisco, assisted with the sidebar on the video project for Snowmass Canyon.

For more information about the project in Snowmass Canyon, visit www.sh82.com/snowmasscanyon.html.



Joseph J. Kracum, Kracum Resources, LLC

In August 2003, the up-valley lanes were near completion. Since this photo was taken, traffic has been diverted to the now-completed up-valley lanes.

Spotlight on the South

Innovative highway projects in seven southern States demonstrate environmental leadership.

by Gary Strasburg

Environmental leadership takes various forms of preserving and protecting a community's resources. Transportation experts, professional planners, environmental engineers, naturalists, historical societies, and keepers of cultural integrity are learning to work hand in hand when roadways need to be expanded or modified.

Several southern States gathered last May in Raleigh, NC, at the 2003 Southern Environmental Leadership Summit to learn how they are each approaching transportation network changes in ways significantly different from the past.

"Transportation agencies in the South, with the many beautiful environmental resources in the region, have become leaders in developing transportation facilities that protect and enhance the natural and human environment," says Marcus Wilner, planning and program development manager for the Federal Highway Administration's (FHWA) North Carolina Division Office. "The Leadership Summit provided an opportunity for many States to showcase transportation initiatives that are fine examples of environmental leadership, stewardship, and streamlining."

Take a look at some of the environmental initiatives from North Carolina, Missouri, Texas, Florida, Mississippi, South Carolina, and Kentucky.

(Above) Using the principles of context-sensitive design, the Mississippi DOT is working with the community to develop design alternatives for a highway-widening project that will preserve the area's cultural resources, including plantation houses like this one.

North Carolina Develops Unprecedented Partnership

In 2003 FHWA recognized the North Carolina Department of Transportation (NCDOT) and the North Carolina Department of Environment and Natural Resources (DENR) with an Environmental Leadership Award for their unprecedented level of communication and cooperation. Their partnership led to creation of a senior leadership team made up of the secretaries and deputy secretaries from each department, who meet monthly to discuss strategic issues about transportation and the environment. FHWA and the U.S. Army Corps of Engineers also participate in the senior leadership team. This leadership team is the first of its kind in the Nation and serves as a model for interagency partnerships for environmental stewardship and streamlining. The team has overseen improvements in the environmental permit approval process, air quality programs, and landmark wildlife conservation.

The centerpiece of the partnership is the Ecosystem Enhancement Program, or EEP. This program will enable NCDOT to implement wetlands and stream mitigation (actions that affect wetlands, watersheds, and other open water areas, including filling, excavating, flooding, draining, clearing, or similar changes) for transportation projects in advance of construction—saving time, reducing costs, and enhancing the State's valuable natural resources.

In addition, DENR and NCDOT established a formal dispute resolution procedure to ensure that difficult interagency issues are resolved early. To encourage participation by DENR staff throughout all phases of the development of transportation projects, implementation, and maintenance, NCDOT currently funds 22 positions within DENR. These staff members bring up issues and concerns early and help develop proactive ways of dealing with them. Some of the positions provide joint environmental training to NCDOT, DENR, and other State and Federal agency staff.

Charlie Jones, NCDOT

An aerial view of the Cherohala Skyway, a scenic parkway in the Great Smoky Mountains in western North Carolina.

Other Initiatives

DENR and NCDOT identified appropriate locations to place signs along primary routes designating the boundaries of each river basin. The river basin signs were purchased through a grant from the Federal Enhancement Program, and NCDOT installed them. The State map features the 17 river basins and contact information for DENR's Office of Environmental Education, which sponsors the River Basin Signing Program.

Basinwide Restoration Plans, which are comprehensive water quality improvement plans, are being developed by DENR's Wetland Restoration Program largely through NCDOT's grant of $2.5 million annually for 7 years. These plans will enable wetlands and stream mitigation to be targeted toward addressing the specific water quality needs of a particular watershed most effectively.

The North Carolina Air Quality Roundtable, cosponsored by NCDOT, DENR, and other partners, is a workshop series convening representatives from 30 groups to work cooperatively to improve the State's response to air quality concerns related to transportation.

In January 2002, NCDOT partnered with DENR and the U.S. Fish and Wildlife Service to acquire 1,013 hectares (2,500 acres) of land in Hoke County to establish a preserve for the federally endangered red-cockaded woodpecker. This effort preserves five colonies of woodpeckers and links together an important ecosystem of longleaf pines throughout the Southeast.

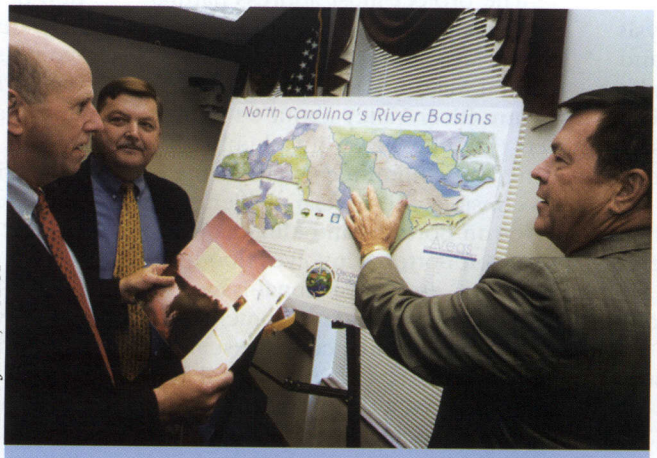
In October 2002, NCDOT and DENR contributed $720,000 toward the purchase of Bird Island, the State's last privately owned barrier island, which is now part of the North Carolina Coastal Reserve System. Bird Island contains 60 hectares (147 acres) of high ground and 466 hectares (1,150 acres) of submerged lands comprised largely of salt marsh. The island is home to many rare species.

In July 2003, NCDOT partnered with the North Carolina Wildlife Resources Commission to purchase and preserve 1,782 hectares (4,400 acres) of Needmore Tract in Swain County. The purchase is one of the most ecologically and economically important conservation efforts underway in western North Carolina.

With assistance from the Federal Enhancement Program, the State agencies also participated in the purchase of two viewsheds along the Blue Ridge Parkway in the Appalachian Mountains in western North Carolina.

"Protecting the environment is a top priority at NCDOT," says Deputy Secretary Roger E. Sheats, head of environment, planning, and local government affairs for the agency. "With this aim in mind, our leadership team has focused every attention on our partnership with DENR. Our success is a direct result of our common vision and serves as proof that it is possible to build a transportation system that protects and enhances our State's precious and natural resources."

Learn more about NCDOT's environmental stewardship and streamlining efforts at www.ncdot.org/secretary/envsteward.



Charlie Jones, NCDOT

(Left to right) North Carolina DENR Secretary Bill Ross, NCDOT Deputy Secretary Roger Sheats, and NCDOT Secretary Lyndo Tippett review a river basin map.

Missouri Addresses Interstate's Environmental Issues

In 1999, the Missouri Department of Transportation (MoDOT) conducted an internal feasibility study of I-70

between Kansas City and St. Louis to determine the condition of the road and the need for improvements. One of the Nation's oldest interstate highways, I-70 was built between 1956 and 1965. In fact, the first section of interstate constructed nationwide was in St. Charles County just outside St. Louis. The study concluded that improvements were needed and that potential changes would be identified through a tiered environmental approach that was expected to reduce the traditional environmental study process by 2 years.

MoDOT

I–70 in Missouri, shown from an overpass, is one of the Nation's oldest interstates, built between 1956 and 1965. It is characterized by aging pavement, a narrow median, and narrow shoulders.

The tiered approach was the first for Missouri and started in January 2000. It was set up to be a collaborative decisionmaking process to obtain early input and acceptance from the Federal and State resource agencies on the process and strategy that could be advanced in the second-tier studies. The study offered a broad view of seven improvement possibilities that ranged from doing only repair and maintenance to alternatives that could accommodate high-speed rail. It also allowed for an expansive view of the nearly 322 kilometers (200 miles) of the corridor. After analysis and public input, the widening and reconstruction strategy of the existing highway was chosen as the best way to address the corridor's issues of safety, congestion, road condition, and environmental impacts. The study team identified seven sections with independent utility and logical termini that could be advanced as separate environmental studies during the second-tier studies. The team presented these in the first tier final environmental impact statement (EIS).

The second tier studies were launched in 2002 to determine how best to implement the statewide strategies while being sensitive to the needs of the local communities. Comprehensive environmental and community impact decisions are being made throughout this process, supported by a general engineering consulting firm and seven section consulting firms. In addition to the environmental studies for each section, one of the three subcommittees that were formed (see page 33) completed a corridorwide enhancement plan to illustrate the context-sensitive solutions that are possible to mitigate impacts and showcase Missouri and the communities along I-70.

The project must address natural resource issues at Overton Bottoms at the Missouri River crossing in central Missouri and Mineola Hill/Loutre River Valley about 64 kilometers (40 miles) east of Columbia. Two other subcommittees were formed to consider the special challenges at Overton Bottoms and Mineola Hill. Overton Bottoms involves floodplain, wetlands, and recreational issues that could lead to the development of a nature interpretive center-rest area. Mineola Hill has archaeological and historic sites, a threatened and endangered species, a State park, recreational issues, steep grades, and natural areas just off the existing highway. Adding to these challenging environmental issues, existing development flanking I-70 in Columbia and the approach to metropolitan St. Louis will make widening efforts difficult. In the rural areas, most affected businesses are located in the immediate area of each interchange.

The process has involved thorough examination of local options within the context of engineering standards to avoid, minimize, and mitigate natural and community impacts. One of the most contentious locations is at Kingdom City where a number of travel service businesses are located close to a confined diamond interchange and are totally dependent on the interstate traffic.

MoDOT continues to involve agency partners, communities, and other local citizens rigorously in the decisionmaking process to obtain their ideas and keep them informed. The comprehensive approach will allow MoDOT to proceed with needed short- to intermediate-term investments, says Bob Brendel, outreach coordinator for project development with MoDOT. As an example, since 13 bridges within the corridor will soon need to be replaced, completion of the environmental study will help determine how those bridges would span the ultimate facility so that MoDOT does not build a structure that would need to be replaced in 5 to 10 years during any lengthy rebuilding process.

To learn more about this MoDOT project, visit www.improveI70.org.

Texas Initiates a Grand Vision

The Texas Department of Transportation (TxDOT) formed the Texas Environmental Resources Stewards (TERS) in July 2002 as the result of two initiatives. First, the Transportation Equity Act for the 21st Century (TEA-21) requires the U.S. Department of Transportation to streamline the environmental approval process. Second, in the spring of 2002, newly

inaugurated Texas Governor Rick Perry called for creation of a transportation system to rival the scope of the interstate highway network. Governor Perry's vision is to have 6,440 kilometers (4,000 miles) of transportation corridors within Texas incorporate separate lanes for cars and trucks; separate tracks for high-speed passenger rail, commuter rail, and freight rail; and a 61-meter (200-foot)-wide easement for utilities such as fiber optic cable and pipelines for water and petrochemicals. The Governor tasked TxDOT with preparing an action plan to create the new system, dubbed the "Trans-Texas Corridor."

In June 2003, Governor Perry signed legislation giving TxDOT the authority to proceed with the Trans-Texas Corridor, which includes the I-69 corridor, among others, and will incorporate what is learned by TERS in implementing I-69. The State's 1,610 kilometers (1,000 miles) of I-69, with 13 to 15 Segments of Independent Utility (SIUs), will include some Trans-Texas Corridor design elements. The interstate is one of the original 21 Congressional High Priority Corridors in the Intermodal Surface Transportation Efficiency Act of 1991 and also was chosen in 2002 as a streamlining pilot project under TEA-21. Therefore, another precipitating factor for TERS was the initiation of the I-69 project for which the State chose to assess the environment of the entire corridor in one fell swoop.

The TERS working committee includes staff from TxDOT, the U.S. Environmental Protection Agency, U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, FHWA, Texas Parks and Wildlife Department, Texas Commission on Environmental Quality, the Governor's office, and The Nature Conservancy of Texas. The group's goals are to identify high-priority ecological and potential mitigation areas, while streamlining the regulatory processes.

"Agreeing on what is important is not easy," says Dominique Lueckenhoff, former transportation liaison with the U.S. Environmental Protection Agency. "Leaders of each agency are involved in and support the process. TERS is designed to improve how we collaborate in areas of ecological concern with our sister agencies."

Subcommittees of the Improve I–70 Study Management Group

Enhancement: The Corridor Enhancement Subcommittee developed an enhancement plan for I–70 that MoDOT can use in the design phase. The plan is a combination of baseline enhancements (for example, bridge treatments) that will be included as part of the project, along with a menu of additional items that local communities can elect to fund.

Mineola Hill: In this scenic portion of the I–70 corridor in Missouri, the challenge for the section engineer is to widen the interstate and correct substandard grades through the Loutre River Valley while avoiding a number of unique resources:

- Graham Cave State Park
- Graham Farmstead
- "Slave" Rock
- A historic schoolhouse and plantation in Danville
- Loutre Lick access
- Danville Conservation Area
- A second cave and second glade area

The committee is charged with developing a plan for enhancing the area that will feed into the work being done by the section engineer.

Overton Bottoms: This subcommittee examined the opportunities for enhancement and joint development opportunities in the area of the Missouri River crossing in the central part of the State. Following the historic floods of 1993 and 1995, most of the acreage in this vicinity was acquired by various governmental agencies. The committee looked at the public outreach opportunities that could be realized if some type of interpretative visitors' center were constructed in the vicinity in conjunction with the Improve I–70 project.

The subcommittee also will be responsible for fleshing out the specifics of any wetlands mitigation and enhancement opportunities. To some extent, the specifics will have to wait until after the design is completed, but the area has been identified as an opportunity for wetlands banking.

"A big focus of TERS is planning," says Dianna Noble, director of TxDOT's environmental affairs division. "TERS will help us avoid and minimize impacts on the environment."

One tool used by the group is a geographic information system (GIS)-driven model that assesses ecosystem health and terrestrial and aquatic resources. The department's environmental affairs division currently has more than 70 sets of data in the system, ranging from soil types to the locations of bird rookeries. Once the GIS data are complete, the data layers will be available to TxDOT district offices and project consultants through a Web site.

"TERS will identify problematic areas early in the planning process. The advantage of using TERS-generated data on a project is that it will be faster, provide better collaboration between agencies, and identify priority areas that need to be avoided," says Jimmy Tyree, a TxDOT TERS representative.

"The immense scale of I-69 will provide an opportunity to expand the data sets for the GIS system and fine-tune the TERS approach to solving new challenges in protecting the environment while efficiently moving the project ahead," adds Tyree. "TERS is an open-ended system that is constantly updated and improved. It is an excellent tool for protecting Texas' important environmental resources while meeting the demands of large transportation projects."

For more information on the Trans-Texas Corridor, visit www.dot.state.tx.us/ttc/ttc_home.htm.

FDOT District VI, Miami

This completed deer guard (with fencing) is located at a side road that intersects U.S. 1 in the Florida Keys.

Florida Protects Key Deer

The Florida Department of Transportation (FDOT) received the 2003 American Association of State Highway and Transportation Officials' (AASHTO) Center for Environmental Excellence Best Practices in Environmental Stewardship Project Award for its work to protect the endangered Key deer, found only in the keys of southern Florida.

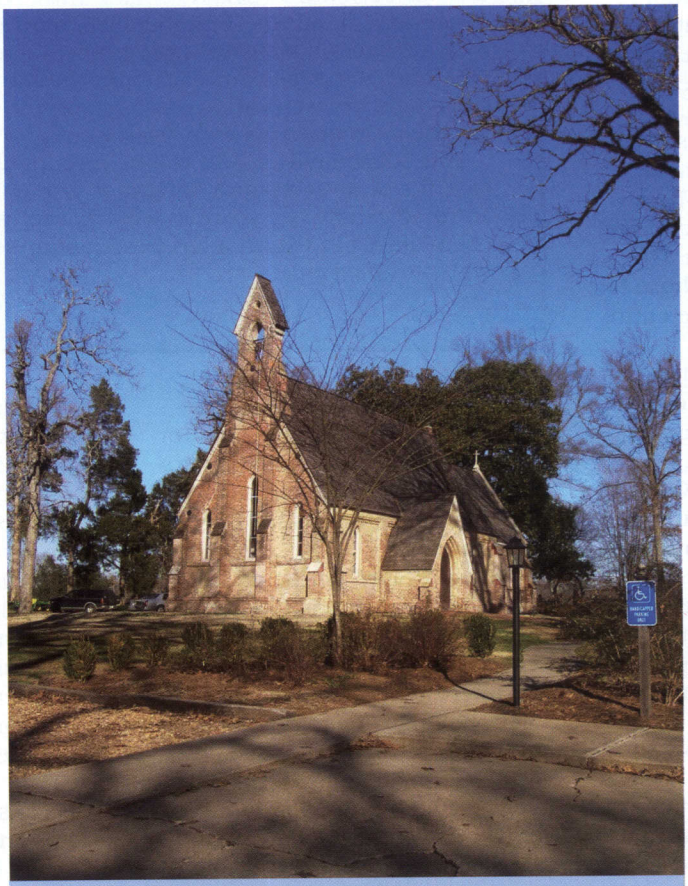
About the size of a large dog, Key deer are the smallest subspecies of white-tailed deer. Bucks range from 711 to 813 millimeters (28 to 32 inches) at the shoulder and weigh an average of 36 kilograms (80 pounds). Does stand only 610 to 711 millimeters (24 to 28 inches) at the shoulder and average 30 kilograms (65 pounds). In the 1940s, the Key deer nearly became extinct, but thanks to the establishment of the National Key Deer Refuge in 1957 and strict law enforcement, the population now is stabilized at around 600–700.

Today, road kills are the Key deer's greatest threat, accounting for at least half of the annual mortality rate. In the late 1980s, FDOT implemented speed reductions, posted deer crossing signs, established a no-passing zone, and introduced a roadside clear-cutting maintenance program to remove trees and shrubbery along U.S. 1 in Big Pine Key where 50 percent of all Key deer road kills occur.

In 1993, however, FDOT recognized the need for a different approach to reducing Key deer fatalities, a concerted effort that would involve various stakeholders. During the next 10 years of research and study, FDOT worked with the U.S. Fish and Wildlife Service, which manages the National Key Deer Refuge; Florida Game and Freshwater Fish Commission; the Key Deer Protection Alliance; the public; and leading authorities on Key deer biology.

These agencies and other stakeholders agreed that the final solution had to provide for a reduction in highway mortality of Key deer but allow them to cross U.S. 1 to access habitat on both sides of the roadway. Improving driver safety and minimizing other environmental impacts also were equal considerations for the project.

As a commitment to the U.S. Fish and Wildlife Service, FDOT agreed to modify components such as the deer guards and fencing if necessary and to fund post-construction monitoring research to evaluate use of the crossing system by Key deer. To conduct the research, Texas A&M University is using radio-marked collars, global positioning system (GPS) collars, and infrared-triggered cameras to provide information on marked deer. The university researchers collected pre-construction data to compare with post-construction data on survival, mortality, movement, and dispersal of Key deer.



Plans for a widening project on Highway 463 near Mannsdale, MS, will preserve historic buildings like the Chapel of the Cross, shown here.

A 3.2-kilomer (2-mile) section of U.S. 1 between Mile Markers (MM) 31 and 33 on Big Pine Key was chosen for a wildlife crossing system built specifically for the Key deer. The area is undeveloped, with naturally occurring mangrove wetlands on either side of the road. The crossing system includes four components:

- Two underpasses were built 1.61 kilometers (1 mile) apart. They are 7.6 meters (25 feet) wide and 2.4 meters (8 feet) high.
- Fencing was constructed to limit deer access to U.S. 1 and to direct them toward the underpasses. The 2.4-meter (8-foot)-high fencing includes clearance from the ground to enable the endangered Lower Keys marsh rabbit passage.
- A travel corridor was created parallel to the fencing. Selective trimming of mangrove wetland vegetation along the fencing channels the deer to the underpasses.
- Deer guards were installed in the roads that intersect or cross U.S. 1. The steel grid decking was specially designed and tested to discourage the small-hoofed deer from crossing the road at these openings in the fence.

In the short time since the wildlife crossings were completed (January 2003), the number of deer killed in this section of highway has decreased significantly. One fatality occurred in August when a deer was able to cross a deer guard. However, in previous years, 15 to 20 deer had been killed in this same stretch of road.

Lights have since been installed at the deer guards to further discourage the deer from crossing. Key deer biologists are watching closely to see how the project affects movement patterns—that is, whether some deer shift their movement away from the "safe" crossings and move to adjacent "unsafe" open areas on U.S. 1.

The Fish and Wildlife Service and FDOT consider the project a success. "The project restored areas of biological connectivity for Key deer habitat that had been bisected by U.S. 1 in the 1930s," says Catherine Owen of FDOT's District VI Environmental Management Office. "It represents FDOT's dedication to work with the local community, regulatory agencies, and the Fish and Wildlife Service to implement a plan that maintains the continuity of vehicular traffic while achieving the objectives of significantly reducing mortality of the Key deer and providing the deer safe access to a large portion of their habitat."

SCDOT

An official and a resident engage in a public information exchange on the status of the Cooper River Bridges Replacement Project in South Carolina.

The success of the project was due to a combination of collaboration, best science, and a flexible design process that enabled critical elements to be modified or refined. Other States have requested information pertaining to the deer guard design.

Mississippi Preserves a Historic Community

Mississippi Highway 463, also known as Mannsdale Road, begins in the city of Madison just north of Jackson, the State Capitol. It extends northwest 13 kilometers (8 miles) to Highway 22. Land use along the route varies from light commercial to upscale suburban to rural. The area includes an important historic district with the remains of a former plantation at Mannsdale. The area's historical value is further enhanced by the 150-year old Chapel of the Cross place of worship. The chapel is on the National Register of Historic Places and has potential for nomination as a National Landmark.

Because of intensive growth in the area, the road needs to be widened from two to four lanes. The project could affect the Chapel of the Cross, whose congregation has a 150-year history in this area. Local residents wished to limit growth in the area to preserve its rich culture. The Mississippi Department of Transportation (MDOT) is incorporating the principles of context-sensitive design by developing two alternatives based on the needs of the public and the community and MDOT's desire to preserve the area's cultural resources.

Early in the project's development, MDOT assembled a citizen's advisory team, including businesses, civic organizations, neighborhood groups, church congregations, and individual citizens in the project area. The team was formed to help the project's decisionmakers understand and address citizen' concerns. The citizen's advisory team will remain a part of the decisionmaking process throughout the project's environmental, design, construction, and maintenance phases.

To provide additional traffic capacity without destroying the character of the community, MDOT recognized that decisions had to enhance rather than conflict with the area's cultural heritage. The goal was to design and build the project so it would emphasize and preserve the area's spirit and history.

A second team, put together by MDOT, includes an environmental consultant, experts from FHWA and MDOT specializing in context-sensitive solutions, design engineers, location engineers, landscape architects, historians, archeologists, civil rights specialists, public involvement specialists, right-of-way professionals, and maintenance specialists.

"This team and the citizen's advisory team are moving the process from impasse to the selection

SCDOT

This house in Charleston, SC, was scheduled for demolition, but here it is being moved for donation to the city of Charleston to use for affordable housing.

of solutions that will enhance the history and culture of the area," says Cecil Vick, environmental team leader of the Mississippi Division of FHWA. "MDOT is not making decisions based on *its* perceptions of what would be best for the community. Rather, it took the time to learn about the community's values and incorporated those values into decisions about the project's construction."

Vick adds, "The ongoing process is moving toward a design that provides optimal traffic capacity while touching lightly on the land. The new roadway will have a low profile with minimal visual impact. It will use landscaping, lighting, and architectural features that blend into the terrain and complement the area's historic character. Through this process, MDOT should arrive at solutions to mounting traffic problems that if unchecked would eventually have their own destructive impact on a culturally rich historic community."

South Carolina Employs Context-Sensitive Solution

The Cooper River Bridge Project in South Carolina is the largest single transportation project in the State's history. It is also a successful example of context-sensitive solutions.

This $667 million design/build project will replace the deficient Grace Memorial and Silas Pearman bridges over the Cooper River. When completed, the new Cooper River Bridge will connect Charleston with the town of Mount Pleasant, and it will be the longest cable-stayed bridge in North America.

From start to finish, the public participated in choosing the bridge type, shape, and lighting. The South Carolina Department of Transportation (SCDOT) has an onsite community bridge office where members of the public can ask questions or provide comments about the bridge. SCDOT also hired community liaisons to assist with community issues and concerns.

The level of community involvement on this project resulted in several suggested mitigation and enhancements activities, many of which have been or will be incorporated into the project including:

- Historic preservation—Mechanically stabilized earth walls were added to protect and preserve historic buildings outside the right-of-way.
- Construction mitigation—Sequencing was revised to reduce nighttime work immediately adjacent to communities.
- Affordable housing—SCDOT donated many of the homes within the project alignment (which would otherwise have been demolished) to the City of Charleston to be moved to other locations and used as affordable housing.
- Street improvements—The main street through the community will be greatly improved in both aesthetics and function.
- Educational and job training programs—Educational programs and academic experiences have been developed that encourage secondary school students to pursue professions in the transportation industry. Training programs provide job readiness skills and on-the-job training.
- Recreational enhancements—A pedestrian and bicycle group ensured that a walkway is part of the design.

In addition, SCDOT is using the philosophy of context-sensitive design to reduce the potential effects of the bridge's lighting on loggerhead turtles. After the turtles lay their eggs on the beaches, the hatchlings find their way to the sea by following the natural light of the moon or toward what appears to be the brightest light. To reduce the potential adverse effects of the bridge lighting, SCDOT implemented a variety of measures:

- Eliminating overhead sign lighting in favor of high-grade reflective sign sheeting that allows drivers to read the sign information safely without the need for supplemental lighting
- Eliminating high-mast omnidirectional lighting at the two interchanges in favor of short-mast directional lighting that concentrates the light where it is needed
- Reducing lighting system wattage from 1,000 watts to 250 watts per bulb
- Installing a lighting control system that enables the aesthetic lighting on the towers and cable system to be turned off at strategic times

"Not only will the new Cooper River Bridge be a beautiful and safe

structure that everyone had a part in, but it will also be a model showing how SCDOT and FHWA are implementing context-sensitive solutions to deliver a high-quality transportation facility," says FHWA South Carolina Division Administrator Bob Lee.

Kentucky Incorporates Environmental Justice

The Commonwealth of Kentucky, through the Kentucky Transportation Cabinet (KYTC), has developed an environmental policy that could serve as a benchmark for future projects and mitigation efforts nationwide. The Newtown Pike Extension project, located in Lexington, KY, in Fayette County, is an example of implementing that policy. The project is a new 2.4-kilometer (1.5-mile) boulevard connecting West Main Street at Newtown Pike and South Limestone Street at Scott Street, plus a 10-hectare (25-acre) neighborhood redevelopment to mitigate environmental justice impacts.

The Newtown Pike Extension has been part of Lexington's planning as far back as the late 1930s. Previous attempts were opposed because they did not adequately address impacts to the communities along the route. With the completion of the environmental study in June 2000, the creation of a citizens advisory committee, and an intense public involvement process, the project began to pick up momentum.

A planning consultant created a corridor plan that was incorporated in the Lexington Fayette Urban County Government Comprehensive Plan. The corridor plan provided the framework to address environmental justice issues involved in redevelopment.

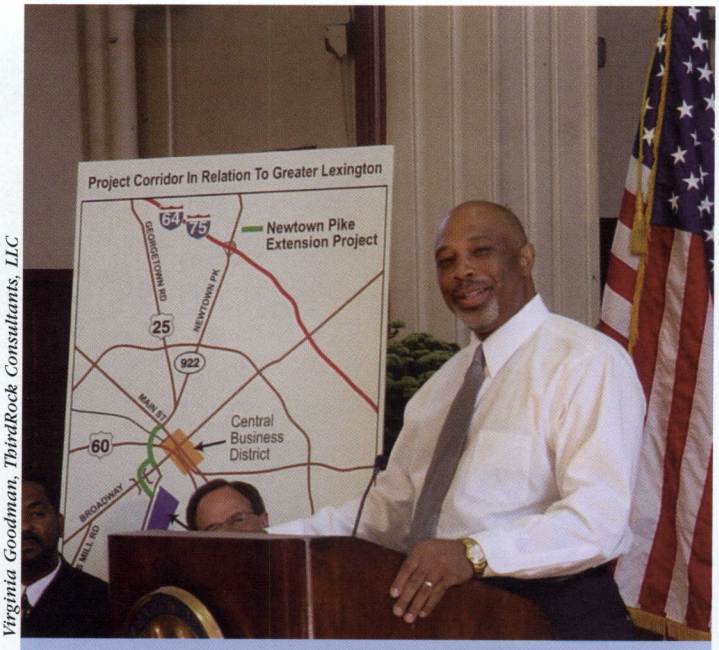
As the public involvement process began, the citizens advisory committee and affected neighborhood residents requested that the project fund a community liaison employed by the project itself, not by the county government, KYTC, or FHWA. Dorothy Coleman was brought on board to be the public's voice for all aspects of the project. "Her role facilitating communication and building trust has been a key to the success of the project to date," says Bill Gulick, assistant State highway engineer in the State Highway Engineer's Office.

With the corridor plan approval in November 2002 and the draft Environmental Impact Statement (EIS) underway, the cumulative socioeconomic impacts of construction became clear. The new road would increase property values, and market forces would pressure Davis Bottoms, a low-income housing area, to redevelop, forcing the existing residents out of the downtown area. To keep the community intact, a complete neighborhood reconstruction is planned for the 10-hectare (25-acre) area, with new streets, utilities, an upgraded park, and enhanced community services. The project will be partnering with the U.S. Department of Housing and Urban Development (HUD) to provide housing opportunities in the reconstructed neighborhood.

This project is one of the first opportunities the KYTC has had to incorporate road planning and neighborhood planning in one project. It filled a gap in urban road design by using Lexington's municipal resources to mitigate local problems and involved partnering with the University of Kentucky and FHWA. On August 12, 2002, former Kentucky Secretary of Transportation James C. Codell III, University of Kentucky President Lee Todd, Lexington Mayor Pam Miller, and Jose Sepulveda of FHWA signed a guiding principles agreement that neighborhood redevelopment and housing will be top priorities for the project.

Visit http://transportation.ky.gov/KYTCEP1.HTML to learn more about the policy driving the Newtown Pike Extension.

These are just a few examples of environmental leadership in the South. It takes this kind of commitment and leadership to make changes and to work more closely with partners and the community.



Virginia Goodman, ThirdRock Consultants, LLC

Eugene Cleckley, director of FHWA's Resource Center-Atlanta, addresses the importance of the guiding principles document for Kentucky's Newtown Pike Extension project.

Gary Strasburg is the public affairs specialist for FHWA's Resource Center-Atlanta (RC-A). In that position since March 2002, he brings a wealth of experience as a public affairs officer with the Air Force Reserve. In that capacity, he was able to publicize many Air Force Reserve activities and looks forward to the opportunity to highlight the work that is being performed by the RC-A. He can be contacted by e-mail at gary.strasburg@fhwa.dot.gov or by phone at 404-562-3668.

For more information on the summit or for contacts on the individual projects, contact Marcus Wilner, planning and program development manager, FHWA North Carolina Division Office, at 919-856-4330, Ext. 115, or marcus.wilner@fhwa.dot.gov.

The AIRS Approach to Analyzing Intersection Crashes

By Jessica Rich

A transportation management center in Kentucky pioneers a new recording system to improve driver safety and accountability.

The Federal Highway Administration (FHWA) is dedicated to achieving success in several aspects of highway management, but its chief interest always has been to maintain safety on the Nation's highways. The goal is to reduce roadway-related fatalities and injuries by designing a forgiving infrastructure and educating road users about highway safety and technologies. The U.S. Department of Transportation's (USDOT) goal is to achieve a 33 percent reduction in the motor vehicle fatality rate by 2008.

FHWA has identified intersection safety as one high-risk area of highway safety. Each year, more than 2.8 million intersection-related crashes occur in the United States, representing more than 44 percent of all reported crashes.

The American Association of State Highway and Transportation Officials (AASHTO) targets intersection safety as one of the emphasis areas in its Strategic Highway Safety Plan. In November 2001, AASHTO held a workshop to identify various issues related to intersection safety and to develop a national agenda on intersection safety. Those participating in the workshop identified the lack of research focused on the intersection problem as one important issue and offered a number of concerns related to research, such as the lack of reliable data on the effectiveness of safety countermeasures. In addition, participants pointed to the need for improved understanding of intelligent transportation systems (ITS) and data on failure mechanisms in the driver decisionmaking process.

To address these issues, AASHTO has been conducting research and evaluating advanced technologies for intersection safety. "Researchers and engineers need to work together to discover the problems at intersections," says Barney Leslie, a project manager for Traffic Response and Incident Management Assisting the River Cities (TRIMARC) in Louisville, KY and southern Indiana. "The Auto Incident Recording System (AIRS) is a cooperatively produced tool that will aid in this effort."

AIRS is a sound-actuated video recording system used to help analyze the reasons for traffic conflicts at intersections. The idea for AIRS came about when Makoto Koura, of the Mitsubishi Electric Company, invented a monitor/recorder to analyze and improve his golf swing and then later applied the idea to development of AIRS by the Japanese company in 1995. The system was first implemented in Japan to help traffic police analyze high-incident intersections, study the causes of these crashes, and implement countermeasures such as installation of pavement markings to help prevent future incidents.

About AIRS

AIRS consists of two video cameras located on two corners of the intersection to capture incidents from different perspectives. The system also includes two directional microphones (one per camera) that listen for "crash-like" sounds such as "metal-against-metal" contact, broken glass, horns honking, and squealing brakes. A series of digital signal processors and recording media transmit the sounds and images to a video cassette recorder (VCR) for easy access and analysis.

The video cameras capture three stages of each crash or "near-incident"—before, during, and immediately after. Video and sounds are recorded continuously on an 8-sec-

(Above) An aerial view of the high-crash intersection of Brook Street and Jefferson Street in downtown Louisville, KY.

All photos: Northrop Grumman Mission Systems and TRIMARC.

ond digital memory loop. This continuous loop eliminates the task of watching countless hours of video that do not contain crashes. When the system detects an evident collision, another 4 seconds of video capture ensues. Then the 8-second loop is transmitted to a video recorder in the unit, capturing the sights and sounds of the intersection 4 seconds prior to the crash, during the instant of the crash, and 4 seconds after the crash. Afterwards, the system returns to recording 8-second loops until another crash or "near-miss" incident occurs. The system also captures the phase of the traffic signals by monitoring the current to the signal head and pedestrian signs. The signal phase then is encoded onto the recorded video for review. A benefit of the system is that near-incidents triggered by tires squealing or horns honking allow the traffic engineer even greater insight into traffic patterns at the intersection and driver habits.

The cameras can be mounted easily onto existing signal poles or onto temporary wood poles. The interface to the signal system is nonintrusive and therefore does not require any modification or merging with the intersection signal controller. The installation of the entire system takes about 2 days. In addition to the video cameras and directional microphones, the installation package also includes a cabinet that houses the AIRS controller, its digital video and signal processors, a VCR and its controller, and a signal phase detection unit.

The system also contains incident analysis software, a simulation program that makes it possible to view each phase of the incident, the point of contact, and the speed of the vehicles during the incident. Traffic officials, including crash reconstructionists, police, and city traffic engineers, use these pieces of information when analyzing the incident to determine problem areas and potential improvements to the intersection. Traffic officials need a VCR to view the videos, and they typically use a scanner in conjunction with the incident analysis software.

Setting Cooperative Goals

In 2001, TRIMARC became the first transportation management group in North America to test AIRS. Serving as the transportation management center for the greater Louisville, Kentucky/Southern Indiana urbanized area, TRIMARC is committed to using intelligent transportation systems and innovative transportation technologies to save lives, time, and money. TRIMARC posed several specific goals to pursue in conjunction with AIRS. The team plans to work with the Kentucky Transportation Cabinet to achieve a 10 percent decrease in intersection crashes by fiscal year 2008. By collecting data at a high-incident intersection within the city and studying the frequency and types of incidents occurring at the intersection or approaching it, TRIMARC hopes to lay the groundwork for achieving this goal.

The second key goal is to reduce the crash average at one of Louisville's most dangerous intersections. TRIMARC has been using AIRS for about 2 years at the high-crash intersection of Brook and Jefferson streets in downtown Louisville. The intersection includes two one-way streets with adjoining exit ramps from I-65 (southbound). A gas station is located at the southwest corner and a hotel at the northwest corner. Major hospitals in Louisville are located within six blocks of the intersection, and a fire station is less than a block away, contributing to Brook and Jefferson's average of one crash per week (283 in a 5-year period).

The partners hope to reduce the crash rate at this intersection by studying driver behavior and using this information to determine countermeasures. Local traffic engineers implemented, monitored, and modified countermeasures at this intersection using information drawn from AIRS to analyze their effectiveness. TRIMARC's goal is to deploy the system just long enough to gather sufficient data to increase safety at this intersection and then move the system to another high-incident location. The system also may be deployed eventually to intersections without traffic signals.

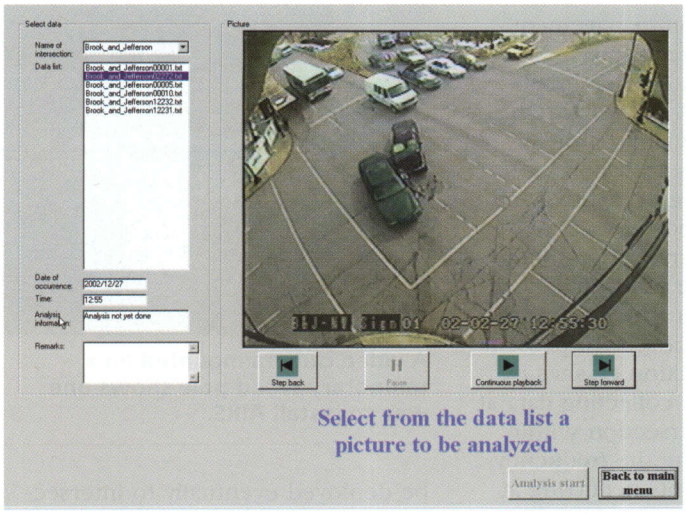
A video camera mounted on a temporary wood pole shows one way to install AIRS.

Effective Countermeasures At Brook-Jefferson

Engineers' review of the AIRS data over the first 5 months found that turns from the Brook Street ramp were the predominant cause of crashes at the intersection and were occurring at a rate of 1.25 per month. The city of Louisville made several modifications to the intersection and evaluated the effectiveness of those modifications, using the AIRS video. Changes included the extension of the traffic island for the Brook Street ramp traffic and additional signage on lane assignments for motorists going north on Brook Street.

During the 6 months following these modifications, only three crashes involving vehicles from the Brook Street ramp occurred. Since then, the intersection has experienced only 15 crashes in almost 2 years. Previously, the crash rate was nearly 5 crashes per million vehicles entering the intersection. Now, the rate is 0.70 crashes per million vehicles. In addition, incidents associated specifically with the turns from

The AIRS analytical tool can retrieve a frame from each portion of a single incident.



A vector can be drawn from each car and linked to determine the angle of collision. This information can help in analyzing errors in the design of the intersection.

the Brook Street ramp have been reduced to a current rate of .67 per month, a 50 percent reduction from the previous rate of such crashes. "AIRS thus has proven itself already as a reliable analytical tool," says Leslie.

AIRS allows for almost instantaneous analysis of the effectiveness of countermeasures because of its ability to use real-time data for a detailed study of the recorded "near-miss" events without having to wait for relatively infrequent crash events. Benefits include improved planning for future intersections from analyzing the mistakes in current designs and reduced crash rates that, in turn, will decrease fatalities, injuries, and damage to property. Reducing the incidence of crashes and injuries also will lessen the associated monetary costs.

Perhaps the most significant benefit of AIRS is its portability. Once the system has been used to improve one intersection, it can be moved to another high-crash location. This feature contributes to the system's economy and effectiveness.

The Future of AIRS

The quick analysis capability provided by AIRS has been highly effective in improving the traffic efficiency and safety at the Brook and Jefferson intersection, especially by providing thorough documentation of crash events occurring during the study period. Since the Brook and Jefferson deployment is the first AIRS installation in the United States, engineers have monitored the intersection closely for nearly 2 years, evaluating the effectiveness of the system and gathering traffic information.

Leslie believes that the 2-year history of the effectiveness and value of AIRS is now sufficient for other transportation and safety engineers to take advantage of the system. "I really expect to start to see deployments to other areas of the country," says Leslie.

He also believes that the video has given city and State traffic engineers additional insight into the dynamics of the intersection and the causes of incidents and near-incidents. Previously, that information was not readily available or was too costly to acquire since it would have required 24/7 surveillance.

The Kentucky Transportation Center (KTC) at the University of Kentucky College of Engineering in Lexington plans to conduct its own evaluation of the overall effectiveness of AIRS. The center will evaluate both the cost-benefit ratio and past success as a data collection and analysis tool. The final goal of this study is the development of a recommendation concerning whether additional systems are warranted and, if appropriate, a plan for deployment. The intent of the study is to provide the Kentucky Transportation Cabinet (KYTC) with an understanding of the relative gains associated with detailed data collection of intersection incidents and incident recording systems.

The results of the study will determine whether the Cabinet purchases and installs another system at another high-incident intersection. The Kentucky Transportation Center anticipates that the final evaluation and report will be completed by June 2005.

Award Winner

In 2002, ITS America recognized TRIMARC and KYTC with the "Best of ITS" award in the area of research. In October 2003, KYTC was picked from 128 applicants to receive the FHWA Office of Safety's National Roadway Safety Award in the category of program planning, development, and evaluation, for its work in using AIRS. The deployment of AIRS was a successful partnering effort between the Kentucky Transportation Cabinet, Northrop Grumman Mission Systems, the Louisville Metro Police Department, the Metro Department of Public Works, and the Mitsubishi Electric Company.

"I think everyone assumed a little risk in being the first in the country to attempt this, but I believe the safety results we are now attaining justifies everyone's willingness to see this through," says Leslie. The distributor continues to work with other communities, engineering firms, and the insurance industry to encourage the use of the AIRS at high-incident intersections.

Jessica Rich is in her first year as a highway safety engineer for the FHWA Kentucky Division. Rich has a B.S. degree in civil and environmental engineering from North Carolina Agricultural and Technical (A&T) State University and an M.S. in civil engineering from the University of Tennessee. Rich has previously worked for the North Carolina Department of Transportation, the Transportation Institute of North Carolina A&T State University, the Center for Transportation Research at the University of Tennessee, the city of Knoxville, and the Knoxville Transportation Planning Organization. Her past experiences include surveying, research, transportation planning, and traffic engineering.

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Resource Center Goes National

by Steve Moler, Marie Roybal, and Gary Strasburg

Four FHWA regional centers become one national center operating through virtual teams that can be placed anywhere across the country.

The challenge was a section of I-10 through San Antonio, TX, where the highway was to be widened over an existing culvert that was structurally unable to support the weight of traditional embankment fills. The Texas Department of Transportation (DOT) was dissatisfied with the identified solution—using a reinforced concrete mat supported on drilled shafts to span the culvert and support the embankment fill. So the agency approached the Federal Highway Administration's (FHWA) Texas Division Office, which turned to the FHWA Resource Center's geotechnical engineering and hydraulics technical service team for an innovative solution. The team suggested constructing an embankment using expanded polystyrene (EPS) geofoam blocks as a lightweight alternative. With about 1/100th of the weight of soil, the geofoam fill could be easily supported by the existing culvert. State and Federal engineers estimated significant project savings in time, money, and manpower. Cost savings alone were estimated to be more than half of the $8 million for the original design.

(Above) Workers place geofoam blocks for an approach embankment in Boston. On a Texas project, FHWA's Resource Center suggested that geofoam be used because it has a unit weight of less than 0.9 kilogram (2 pounds) per 0.028 cubic meter (1 cubic foot).

One year into its reorganization, FHWA's newly consolidated Resource Center provides technology deployment, training, and technical expertise for transportation customers nationwide. Innovative solutions to complex problems and world-class technical expertise are what FHWA's Resource Center does best.

"With this new functional and organizational structure, FHWA will be better able to embrace new ways of thinking and to support program delivery with technical assistance and technology deployment across the Nation," says Glenn Clinton, manager of the Resource Center office in San Francisco. "We have enhanced our ability to deliver better, more timely service to our customers."

Evolution of the Resource Center

The Resource Center was formed in 1998 as part of a major reorganization that included restructuring headquarters into 13 new offices, eliminating regional offices, and delegating program authority to the agency's 52 division offices. The division offices directly administer the Federal-Aid Highway Program in each State and in the District of Columbia and Puerto Rico. Under the 1998 reorganization, the four Resource Center offices—located in Atlanta, GA; Baltimore, MD; Olympia Fields (Chicago), IL; and San Francisco, CA—served as a repository of technical expertise but held no delegated authority for program issues. The four offices' technical specialists provided expertise in various disciplines to headquarters, division offices, and local and State transportation agencies, within specific geographic boundaries.

Two years later, in January 2000, FHWA conducted an assessment to determine how the 1998 reorganization was faring. This assessment, which used information from 160 focus groups and structured interview sessions with external stakeholders and FHWA employees, confirmed the effectiveness of FHWA's restructuring. The assessment of the Resource Center revealed that its reorganization was successful as well in many ways. For example, eliminating the regional offices and replacing

Central Artery/Tunnel Project

The use of expanded polystyrene (EPS) geofoam as a lightweight fill material for highway embankments on the Boston's Central Artery/Tunnel Project originated at the suggestion of FHWA.

them with the four resource center offices generally was seen as positive.

The assessment also indicated, however, that the agency needed to make further adjustments to the Resource Center to meet customer needs more efficiently. Some functions of the four offices needed refinement. FHWA formed a steering committee, which recommended establishing "centers of excellence" or teams of expertise. Each team would provide technical services in particular discipline areas, such as environment or structures. But instead of maintaining this same expertise in each of the four Resource Center locations, the teams would serve the needs of the entire country in each of their technical areas. Each of these Technical Service Teams (TSTs) contained a "critical mass" of expertise that could be deployed quickly anywhere in the United States.

To help hold all of this together, a board of directors was established to set the overall direction of the consolidated Resource Center. The board defines the skill and service mix provided by the four offices and ensures that this corporate resource is used effectively to balance the needs of headquarters and the field.

Through implementing the recommendations of the steering committee, the Resource Center evolved from a traditional management structure in which each of the four geographically located offices provides the same services to a centralized structure in which specialized teams service the entire Nation.

Designed to provide technology deployment, training, and technical assistance, the reorganized Resource Center was built around the concept of a manager overseeing core staff in each of the four office locations and specialized teams of experts who would respond to customer needs throughout the Nation. These TSTs would be unconventional in the sense that team members would all report to the same team leader but would not occupy the same office space.

The dispersed—or virtual—nature of the TSTs enables them to coordinate responses to requests from customers across the Nation quickly. Although the offices may be hundreds—or even thousands—of miles apart, each team member works as part of a cohesive unit. This structure enables team members to align goals and activities with a national scope, yet continue to provide tailored services to customers on a local or regional level and draw upon the national team for best practices and additional expertise.

Reorganization a Success

The Resource Center's new operating plan was in place by July 2003. Under the new structure, the team leaders for the Resource Center's 11 specialized TSTs are assigned to the office that houses their particular specialty. The grouping of specialties in each office "is based on the interdependence of disciplines and the synergy that can be gained while working with others in related fields," says Joyce Curtis, the Resource Center manager in the Baltimore office.

For example, the San Francisco office provides air quality, environmental, and planning technical services. Olympia Fields, the Resource Center office near Chicago, concentrates on technical services in operations as well as safety and highway design. The Baltimore office pairs the specialty of hydraulic and geotechnical services with structures technical services and also includes civil rights. In the Atlanta office, the focus is on construction and project management, financial technical services, and pavement and materials. The pairings of topics that are interrelated, like construction and pavements, facilitate deploying technology and innovation in the field.

Working with Virtual Teams

"The restructured organization is clearly a change," says Don Cote, environment technical service team leader. "It allows us to use human resources on a national level—bringing the best expertise to a problem wherever it is nationally."

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As the concept of a virtual team is put into practice throughout the Resource Center, various advantages emerge. "Because some team members aren't physically located in the same office as the team leader, we can provide superior, timely service over a wider area while still maintaining team interaction and dynamics by effectively using the latest in communications technology," says Gary White, manager of the office in Olympia Fields. Having team members located throughout the country enables staff to develop an understanding of regional issues, which helps them better serve customers.

Most teams include specialists and dedicated backups. Team members have a specialty or "primary technology" that may require most of their time, but they also assist other team members as a backup. That way, if one specialist is overloaded with requests, customers are not left waiting. Instead, another team member with similar skills steps in to assist customers. At times, there also can be a geographic benefit to using a secondary specialist. "Every one of us in the Resource Center has a national customer base," says Susanna Hughes Reck, technology deployment specialist for the San Francisco office, "yet we typically develop a familiarity with regional issues, too."

On many occasions, she notes, an employee in San Francisco can better serve customers in Sacramento, because not only are they physically located closer to the customer, which makes for timelier and more cost-effective service, but also because of that proximity the San Francisco employee typically will be more knowledgeable about the issue. Partnering the specialists also keeps team members from becoming pigeonholed and allows for succession planning.

There also are advantages from a management standpoint. "The structure of a virtual team helps show more trust in the employee," says Operations TST Team Leader Martin Knopp. Advances in communications technology—such as e-mail, the Internet, and conferencing that uses video, telephone, or Web technologies—make the virtual team possible. "With my office phone forwarded to my cell phone, a laptop, and a PDA [personal digital assistant], I can work from anywhere," says Silas Nichols, a member of the hydraulic and geotechnical TST. Since many team members are frequently on the road providing assistance or training, or presenting at meetings or conferences, staying connected is critical.

Without walk-in access to each other, team members—and their managers—need to make an effort to keep communication flowing. According to Knopp, this structure "forces team members to talk to each other." Using videoconferences for regularly scheduled staff meetings and relying on phone and e-mail communications are techniques that help maintain the cohesiveness of a virtual team.

"With the Resource Center's emphasis on the deployment of technology and the promotion of innovative practices," says Gary Corino, Resource Center manager in the Atlanta office, "it's entirely appropriate that we use the innovative concept of virtual teams and harness state-of-the-art technology to work effectively and efficiently."

"The technology is helpful," says Shoukry Elnahal, team leader for the structures team, "but nothing beats the personal touch. You have to balance the two."

Periodic visits to each team member, holding face-to-face meetings with all team members present,

How to Contact Resource Center Team Leaders

Resource Center expertise is available to assist in maintaining the Nation's more than 4 million miles of streets and highways and keeping 600,000 bridges in the United States in safe and serviceable condition. The Resource Center's 11 technical service teams, team leaders, and their contact information are listed below. Colors represent FHWA's "vital few" priorities of safety, congestion mitigation, and environmental stewardship and streamlining—that each team supports.

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Operations Technical Service
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Pavement and Materials
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Structures Technical Service
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Safety

Hydraulic and Geotechnical Technical Service
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Planning Technical Service
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Safety and Highway Design Technical Service
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Environmental Stewardship And Streamlining

Air Quality Technical Service
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Environment Technical Service
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** The Civil Rights Technical Service Team, located in the Baltimore office, is not listed above because it is interwoven into the different aspects of the "vital few" priorities.*

Specialties of Resource Center Locations

- **San Francisco**: air quality, environmental, and planning technical services
- **Olympia Fields** (near Chicago): operations technical services, and safety and highway design technical services
- **Baltimore**: hydraulic and geotechnical services, structures technical services, and civil rights
- **Atlanta**: construction and project management, financial technical services, and pavements and materials

attending conferences together, and giving each teammate equal attention is paramount to keep a virtual team together.

Putting Expertise into Practice across the Nation

When officials at Great Smoky Mountains National Park in Tennessee and North Carolina wanted to study potential intelligent transportation systems (ITS) solutions to improve mobility, park administration requested assistance from the Eastern Federal Lands Highway Division (EFLHD), which organized a workshop and coordinated within FHWA for local representation and support from the operations TST.

The operations TST's rural ITS specialist, Keith Trimels, is based in FHWA's Wyoming Division. (Although he is located in a division office and not physically in one of the Resource Center locations, Trimels works partly for the Resource Center and partly for the division office—a virtual office hybrid.) Physically sending Trimels across the country from Wyoming to the Tennessee-North Carolina mountains was impractical, even though this was his main field of expertise.

Instead, Trimels coordinated with his virtual team backups, Road Weather Management and Asset Management Lead Ray Murphy, who works in the Olympia Fields office, and Security and Disaster Preparedness Lead Jeff Van Ness, who works in the Baltimore office. Van Ness, the closest in physical location, attended the workshop and worked alongside representatives from the National Park Service, EFLHD, and the FHWA division office while Trimels and Murphy provided long-distance support when needed.

According to Operations Team Leader Knopp, a followup call revealed that the customer was appreciative of the assistance and felt that he had received the support of the whole operations TST. Knopp believes that customers should see the entire operations team and FHWA through the support of each TST individual team member.

The finance TST's approach to helping customers perform consultant audits is an example of Resource Center expertise focused on a problem of national scope. Public accounting firms were struggling to perform State audits of consulting firms without uniform guidance. At the same time, many State DOTs were outsourcing audits because of internal downsizing and an increase in the use of consultants. To add more confusion, consulting firms frequently were doing business in multiple States with different rules.

The finance TST worked with State DOTs to develop a *Uniform Audit & Accounting Guide* that is used by State auditors and public accounting companies that perform audits of consulting firms. Endorsed by the American Association of State Highway and Transportation Officials (AASHTO), the guide is available on AASHTO's Web site, and it provides an easy-to-use index with access to Federal regulations, authoritative literature, and other useful information for performing consultant audits. This audit tool was accepted by all State highway agencies and is being used by their auditors and by public accounting firms. Consulting firms use the guide to understand allowable costs.

In addition to updating the guide, the finance TST offers onsite training for consultant auditors and contracting officers. This training and the guide have increased audit efficiency and shortened the time spent answering questions from accounting firms contracted to outsource audits—all of which adds up to a savings for the States.

Training on another topic with a national scope—low-cost safety improvements—recently was presented by the safety and highway design TST. At the request of a division office and State DOT, the Resource Center developed and piloted a 1-day workshop, then taught three courses in the State with division office and State representatives attending in a "train-the-trainer" capacity. "The workshop," says Team Leader Patrick Hasson, "is already generating a great deal of attention in other locations around the country."

Similarly, when the California Department of Transportation (Caltrans) and metropolitan planning organizations (MPOs) asked FHWA to provide assistance on the topic of effective congestion management systems (CMS), the Resource Center's planning TST answered the call by providing a customized 1-day training session. "The course provided excellent background and fundamental materials for effective CMS and case studies from across the Nation," says Pat Weston of Caltrans.

Because instructors had real-world experience in planning and engineer-

FHWA Resource Center technical training experts review the details of a presentation.

ing, and attendees found added practical insights and value in the course, California asked the trainers to come back to present a 2-day course. The target audience will include MPO staff and the DOT planners and traffic operations engineers.

In another recent training project, the Alaska Division Office asked the environmental TST to provide training and support in understanding the Federal-Aid Highway Program and the National Environmental Policy Act (NEPA) to the Alaska DOT, which had undergone significant changes recently. In September 2003, two onsite training sessions were offered, one for staff-level members of the DOT and the second a daylong executive briefing. According to Team Leader Cote, the training was well received by the participants, and the project provided exactly what was needed when it was needed. The training, says Cote, "enhanced understanding of the process for all involved." This form of short, rapid-response training also complements the National Highway Institutes' (NHI) courses, many of which also are taught by Resource Center experts.

In addition to training, the Resource Center often is a useful facilitator for sharing information. A recent Internet conference on high-performance concrete (HPC) provides a clear example. As State DOTs use more HPC to prevent deterioration of reinforced concrete bridge components (caused by salts and deicing chemicals used during inclement weather and to slow the penetration of moisture, chloride, and other aggressive ions), lessons learned will prove to be valuable.

Workers place high-performance concrete (HPC) on a bridge deck in New Hampshire. The Resource Center recently held an Internet conference on HPC. *Photo:* HPC Bridge Views, *a publication sponsored by FHWA and the National Concrete Bridge Council.*

To communicate these lessons learned, the structures TST hosted a 5-hour Internet conference on HPC technology implementation involving more than 1,000 bridges in the mid-Atlantic and Northeast. Fourteen States, the District of Columbia, and the FHWA Federal Lands Bridge Office made presentations detailing current HPC projects, past problems and solutions, and ongoing research. More than 50 conference attendees traveled no farther than their own computers to hear presenters while viewing PowerPoint® slides and other visual media. Implementation tips ranged from findings that silica fume and fly ash work best for HPC decks to temperature match curing provides more accurate strength results. By facilitating this information exchange, the structures TST was able to provide a tightly focused snapshot of the state of the practice regarding HPC implementation.

Better still, it all occurred over the Internet and required neither travel time nor expenses beyond normal work hours to attend the conference.

Applying the Best Resources

The development of TSTs with teams that contain national topic experts "allows us to put the best resources to the problem at hand without focusing on geography," says Cote. This national presence is a direct result of the Resource Center's reorganization. FHWA division offices act as gateways to the Resource Center; however, State transportation staff also may contact the center directly. For additional information on the Resource Center, its offices, TSTs, staff, or other information, visit the Resource Center Web site at www.fhwa.dot.gov/resourcecenter.

FHWA, Olympia Fields Resource Center

The FHWA Resource Center at Olympia Fields recently piloted a workshop on implementing low-cost safety improvements like this activated flasher that warns drivers as they approach a sight-restricted intersection.

Steve Moler is the public affairs specialist at the Resource Center office in San Francisco, where he provides customers with expertise in public relations, media planning, media relations, and community outreach. Moler also is an instructor for the FHWA media training course. He holds a B.S. in journalism.

Marie Roybal, marketing specialist at the Resource Center office in Olympia Fields, joined FHWA in 2001 after working in the private sector for 8 years. Her experience includes public relations, marketing communications, special events, and services marketing. She holds both an M.B.A. and an M.S. in marketing.

Gary Strasburg is the public affairs specialist for FHWA's Resource Center office in Atlanta. He has been with FHWA for 2 years, and his previous experience includes more than 18 years of public affairs work with the U.S. Air Force and Air Force Reserve.

Along the Road

Along the Road is the place to look for information about current and upcoming activities, developments, trends, and items of general interest to the highway community. This information comes from U.S. Department of Transportation (USDOT) sources unless otherwise indicated. Your suggestions and input are welcome. Let's meet along the road.

Management and Administration

Secretary Mineta Applauds Innovative Financing For S.R. 125 South Project

U.S. Transportation Secretary Norman Y. Mineta recently joined State and local officials at a historic groundbreaking ceremony for the southernmost segment of a construction project on State Route (S.R.) 125 South in southern California. A key element in enhancing the surface transportation system in the growing San Diego area, the project involves developing and operating a toll road to reduce congestion and pollution.

Federal loan assistance was essential to finance the road, providing flexibility in the repayment structure during the project's ramp-up period. The Federal government executed a $140 million loan for the project under an innovative financing program established by the Transportation Infrastructure Finance and Innovation Act of 1998 (TIFIA). The terms negotiated for the loan provide the first example of a partnership acceptable to both TIFIA and a private sector investor.

TIFIA provides Federal credit assistance to major transportation infrastructure projects that address critical national needs, such as intermodal facilities, border crossing infrastructure, highway trade corridors, and transit and passenger rail facilities with regional and national benefits. Although the S.R. 125 project satisfies loan eligibility criteria by falling into the major highway category, funds also may be allocated under the categories of bridges, intercity bus and rail systems, and transit facilities and vehicles.

By enabling USDOT to provide credit assistance (rather than grants) to private sponsors, TIFIA facilitates the accessing of private capital markets for financing major transportation projects.

Roadway Safety Awards Recognize Programs in 13 States

On behalf of the Federal Highway Administration (FHWA) and the Roadway Safety Foundation, FHWA Administrator Mary E. Peters recently recognized projects in 13 States with 2003 National Highway Safety Awards. The awards highlight initiatives that save lives by improving roadway design, operations, and planning. Each year, FHWA offers the awards in the categories of infrastructure improvements; operational improvements; and program planning, development, and evaluation.

Highway programs in Arizona, California, Colorado, Florida, Iowa, Maine, Maryland, New York, Oklahoma, South Carolina, and Washington received awards. A regional traffic system with roadway sections in Kentucky and Indiana also received an award. The winners were selected from more than 130 entries, and included six State transportation departments, a regional transportation consortium, two counties, two cities, and a State police agency.

FHWA recognized some projects for their capacity to reduce crashes, while others were honored for their contributions to pedestrian safety and environmental preservation. The California Department of Transportation, for example, improved the Angeles Crest Highway (S.R. 2) corridor by reducing the speed limit, requiring daytime headlights in one section, instituting a double-fine zone, and installing a guardrail upgrade—all of which led to a marked reduction in crashes. Montgomery County, MD, developed design standards that include provisions for sidewalks and bike paths on residential streets and collector roads to ensure the safety of nonmotorized traffic.

For more information about the winning projects, visit www.fhwa.dot.gov/pressroom/fhwa0333.htm.

Technical News

Innovative Replacement for a Historic Bridge on U.S. 2

As part of a $4 million project, the Washington State Department of Transportation (WSDOT) replaced a 1935 steel truss bridge with an innovative, high-performance weathering steel bridge. The first of its kind in the State to use the high-performance steel, the new bridge is more environmentally sensitive than its outdated predecessor. The structure provides more clearance for debris flowing under the bridge during floods and eliminates the need for supportive piers in the waterway, thereby enhancing fish habitats. In addition, biofiltration swales built into the structure will reduce heavy metals in stormwater runoff; the old bridge had no treatment provisions.

The new bridge is more efficient and economical, requiring less maintenance and offering expanded traffic flow. Built to current seismic standards with no overhead truss, the bridge also eliminates clearance restrictions.

WSDOT

A crane hoists a girder for the temporary bridge that will detour motorists around construction of the new Barclay Bridge on U.S. 2, east of Everett, WS. The old bridge is shown in the lower right corner.

Because the bridge's natural corrosion is designed to create a dense, protective barrier for the structure, WSDOT managers will not need to paint the bridge as often.

To accommodate the larger, more technically sophisticated structure, WSDOT designed the bridge to provide 1.8-meter (6-foot) shoulders and adapted the nearby roadway to ensure the safety of bicyclists and drivers. WSDOT graded and paved U.S. 2 to provide greater sight distances and establish a roadway geometry suited to the 97 kilometers per hour (60 miles per hour) speed limit. The bridge opened to traffic on June 3, 2003.

Washington State DOT

Research Facility to Design Fish-Friendly Culverts

A Federal report in 2001 found that thousands of culverts on Federal lands are too high or steep, disrupting migrating fish. A new research facility adjacent to the Skookumchuck River near Tenino, WA, will serve as a test bed for designing fish-friendly culverts—the metal or cement pipes that funnel water beneath roads. According to the Washington Department of Fish and Wildlife, 33,000 culverts around the State need to be replaced or repaired to enable fish to pass through safely. WSDOT and other agencies and jurisdictions expect to retrofit thousands of culverts during the next few years.

Operated by the Washington Department of Fish and Wildlife, the full-scale facility will provide the scientifically sound information to help develop more effective designs for new or retrofitted culvert installations. The test bed, initiated by WSDOT and other State transportation agencies, will consist of two large steel tanks—one upstream, one downstream—that cradle a 12-meter (40-foot) corrugated steel culvert whose slope rises or falls to mimic various existing culverts. Facility operators also can adjust bed configurations, such as baffles, ladders, and other retrofits, to determine which techniques make it easier for local fish, including several species of salmon, to pass under highways and other roadways.

"Investing in this system provides WSDOT with improved scientific data to ensure that we're spending money on solutions that will work to provide long-term benefits to our environment," says John Peterson of WSDOT's environmental services office.

Washington State DOT

California to Host Conference on Orthotropic Bridges

Recent structural improvements and increasing fatigue strengths have assured engineers that orthotropic (solid steel plate) bridge decks can be expected to have long service lives. As a result, State highway agencies now are using orthotropic decks for major projects.

To educate the engineering community on new developments in orthotropic bridges, the American Society of Civil Engineers (ASCE), USDOT, and eight other sponsors are compiling a 7-day technical program encompassing classes, a conference, and tours of orthotropic bridges in northern California.

Scheduled for August 23–29, 2004, the conference will draw delegates from Asia, Europe, the United States, and elsewhere. Papers will cover a variety of topics, including design, construction, fabrication, wearing surfaces, maintenance, research, and materials. Tours will visit nine orthotropic bridges in the San Francisco area.

Al Mangus, CALTRANS

Overhead view of the Alfred Zampa Memorial Bridge, an orthotropic bridge in northern California.

Event organizers invite members of the engineering community to volunteer as chairpersons or members of planning-related committees to help with organization, financial components, technical aspects, publicity, and tours.

For more information, contact Al Mangus with ASCE, Sacramento Section at 916-961-2723, asce@asce-sacto.org or visit www.orthotropic-bridge.org.

National Research Center Marks New Era In Pavement Preservation

In late 2003, pavement preservation in the United States entered a new era with the dedication of the new National Center for Pavement Preservation (NCPP) at Michigan State University. A partnership created by the Foundation for Pavement Preservation, FHWA, and the university, NCPP will coordinate collaborative efforts among government, industry, and academia.

Pavement preservation is a planned strategy for treating pavements at the optimum time to maximize their useful life, enhancing longevity while lowering lifetime costs. The key to successful preservation is applying the right treatment to the right pavement at the right time. Treatments must be selected carefully and applied when the pavement is still in good condition (that is, with no structural damage).

According to the center's Web site (www.pavementpreservation.org), the American Association of State Highway and Transportation Officials (AASHTO) estimates an annual cost of $92 billion to maintain existing highways over the next 5 years. Making significant improvements could cost as much as $125 billion annually. NCPP advocates improving pavement conditions in a cost-effective way.

In addition to acting as an advocacy group, NCPP also offers several services, including training, outreach, and research management. The center plans to cooperate with the university to create undergraduate and graduate courses and offer continuing education units as well. NCPP also will provide private clients with custom-designed training sessions onsite or at alternate locations. Further, the center will facilitate research projects in conjunction with other academic institutions and the private sector.

For more information, visit the center's Web site at www.pavementpreservation.org.

Wisconsin Uses Pavement Markings To Reduce Speed

In October 2003, the American Automobile Association in Wisconsin sponsored a media event to showcase a successful experimental technique for reducing speed on the Mitchell Interchange of I-94, I-894, and I-43 in Milwaukee, WI. The experiment uses converging chevrons on the pavement and special edgeline markings to encourage drivers to reduce their speeds as they approach a tight ramp. The Milwaukee site is the only installation with this specific pavement-marking pattern in the country, but the idea originated in Japan, where several experiments also have been successful.

The Wisconsin Department of Transportation (WisDOT) installed the markings in 1999 as part of a freeway resurfacing project. WisDOT selected the test ramp for the installation based on traffic volumes and roadway geometry. The ramp had a history of rollovers involving large trucks, causing long road closures. After placing four speed detectors at and near the test ramp and setting up a comparison ramp without chevrons, WisDOT researchers could measure the effectiveness of the installation in reducing speed.

After the installation in May 1999, mean speeds dropped significantly at three of the four detectors, and as much as 24 km/h (15 mph) at one of the detectors. Total crashes on the test ramp dropped from 14 in the preinstallation period to only 8 postinstallation. Although installing chevron patterns on this particular test ramp appeared to result in notable speed reductions, WisDOT researchers suggest that further research is necessary before any definitive statements can be made about overall efficacy.

For more information on the study, visit www.aaafoundation.org/pdf/chevrons.pdf.

AAA Foundation for Traffic Safety

Public Information and Information Exchange

Federal Agencies Sponsor National Trails Day

National Trails Day, organized by the American Hiking Society, will take place this year on June 5, 2004. Held annually on the first Saturday of June, the celebration increases public awareness and support for trails used for activities ranging from hiking and cycling to snowmobiling. This year's theme, "Trails and Health ... A Natural Connection," emphasizes the links between trails, leisure, and exercise.

FHWA's Federal-Aid Highway Program, the largest single funding source for trails in the Nation, is one of several Federal sponsors, including the U.S. Department of Agriculture's Forest Service, the U.S. National Park Service, and the U.S. Department of the Interior's Bureau of Land Management.

"Trails were the beginning of the Nation's highway system, and they benefit both transportation and recreation today," says Christopher Douwes, manager of the recreational trails program at FHWA. "Our trail infrastructure can improve the transportation network by connecting neighborhoods, parks, schools, commercial areas, and transportation facilities, and help people live active and healthy lives."

Planned events across the country include trail openings and ribbon-cuttings, commemorative walks and bike rides, cleanups and new trail constructions.

Don MacFarlane, Appalachian Mountain Club, NH Chapter

Volunteers clear drainage on the Davis Path in the White Mountain National Forest of New Hampshire on National Trails Day 2003.

To learn more about National Trails Day, visit the American Hiking Society Web site at www.americanhiking.org/events/ntd. For more information about FHWA's role in promoting trails, visit www.fhwa.dot.gov/environment/rectrails or contact Christopher Douwes at 202-366-5013 or christopher.douwes@fhwa.dot.gov.

Contraflow Project to Ease Congestion in Hawaii

Recently, the Hawaii Department of Transportation (HDOT) launched a 4-month, $1 million demonstration project to create a morning contraflow lane on Nimitz Highway into Honolulu, HI. The road typically carries more than 3,700 cars (including many carpools) per hour during peak hours. By borrowing a westbound lane, the project provides an extra high-occupancy vehicle (HOV) lane for those commuting into Honolulu. This adaptation creates a 3.2-kilometer (2-mile) extension

of the HOV lane on the H-1 Freeway, which currently ends at the Keehi Interchange, all the way to Pacific Street. The lane operates during the morning peak commute period from 5:30 to 8:30 a.m.

Since the 1950s, Nimitz Highway has been considered one of the most congested roadways on the island of Oahu. Although officials discussed the contraflow plan for more than a decade, area businesses and residents feared it would disrupt commerce and street traffic. HDOT conducted extensive public outreach, however, and a followup survey of 165 area residents and businesses revealed that 75 percent of respondents were in favor of or had no problem with the project.

To help ensure pedestrian safety, HDOT posted signs advising pedestrians to "look both ways" before crossing the contraflow lane. Supplemental warnings will be painted on the sidewalks, and police officers will be hired to assist schoolchildren crossing the highway. Left turns, with the exception of one intersection, will be prohibited throughout the contraflow area.

According to State Transportation Director Rodney Haraga, if the lane proves successful, Hawaii may build an elevated two-lane road along the corridor, which would enable traffic managers to reverse the contraflow lanes in the afternoon.

Hawaii DOT

New Database Tracks ITS Legislation

As part of a cooperative agreement with FHWA, the National Conference of State Legislatures tracks State efforts to use technology and intelligent transportation systems (ITS) to improve the safety and efficiency of surface transportation. The new Intelligent Transportation Systems State Legislation Database tracks current ITS legislation in the States, providing information on bill numbers, summaries, and information on bill status.

Users can search the database by the bill's year, status (active or inactive), sponsor, and the most recent date of action. Constituents also can search by the State in which the bill originated, or simply use a keyword to find the appropriate bill.

The National Conference of State Legislatures' transportation program offers information, research, legislative data, and referral assistance on more than 350 topics. The leading transportation issue areas include distracted driving, drunk driving, hazardous materials, ITS technologies, and rail and traffic safety.

To search the database, visit www.ncsl.org/programs/esnr/its.cfm.

Closing Roads during Construction Enhances Safety and Efficiency

FHWA recently published a brochure on full road closure, an approach to roadway construction that entails closing one or both directions of a road and detouring traffic. *Shorter Duration, Safer Work Zones, More Satisfied Travelers: Successful Applications of Full Road Closure in Work Zones* (FHWA-OP-03-086) is the first product of a study that assessed six field applications that used the approach. Full road closure eliminates worker-traffic interaction and provides workers access to the entire roadway section during construction, potentially improving efficiency and safety and reducing the duration of work.

The brochure provides several case studies detailing significant benefits garnered from projects that used full road closure. Near Detroit, MI, for example, closing the Lodge Freeway during construction reduced project duration by 71 percent. In Portland, OR, the Oregon DOT used two full closures (one direction at a time) to complete a project within 10 days, instead of 32 nights of work using partial closure, and reduced the overall cost of the project by $100,000. Oregon DOT engineers estimate that they could have cut the total project cost of $2.5 million in half if they had specified the use of full closure in the original contract.

The Ohio DOT is using full closure to rehabilitate a major route through downtown Columbus and expects to save up to $10 million by completion. "Under the appropriate conditions," says Gordon Proctor, director of the Ohio DOT, "a full closure can be an effective way to complete projects faster and improve safety for highway workers and motorists."

For more information, visit http://ops.fhwa.dot.gov/wz/docs/Full%20Closure_BRO-final.pdf.

Proceedings Available from Conference On Congestion

Final proceedings now are available from the "Traffic Congestion: Issues and Options" conference, held in Washington, DC, in June 2003. The conference, cosponsored by the Institute of Transportation Studies at the University of California, Los Angeles (UCLA) and the UCLA Extension Public Policy Program, examined the causes and consequences of traffic congestion in the United States and various strategies for tackling the problem.

Although attendees concluded that there is no "silver bullet" for solving congestion, the report contributes to more informed decisionmaking in the reauthorization of Federal surface transportation legislation.

Organized into 11 sections, the report addresses many aspects of traffic congestion, ranging from environmental impacts to potential solutions. A section on the Federal role, for example, describes how increasing population pressures on the Nation's roadways challenge the shrinking financial capacities of local roadway management groups. A section on air quality discusses the respective benefits of traffic flow-based solutions and technology-based solutions to the problem of air pollution. A chapter on market-oriented solutions explores the policy of discouraging congestion by raising toll prices for rush hour traffic.

Access the final report online at www.uclaextension.edu/unex/departmentalPages/publicpolicy/report.pdf.

USDA Forest Service

FHWA Reports on Traveler Information Systems in Europe

The FHWA Office of Policy recently released a report summarizing the findings from a scan tour of traveler

information systems in Europe. Based on data gathered during a tour conducted in October and November 2002, *Traveler Information Systems in Europe (FHWA-PL-03-005)* illustrates innovations in informational products for tourists and travelers.

The scan team identified eight cities in Europe that operate well-established traveler information products and services that reflect all transportation modes. A panel, cosponsored by FHWA and the American Association of State Highway and Transportation Officials, reviewed and documented the practices, policies, strategies, and technological innovations and evaluated them for potential application in the United States. The timing for the tour also enabled the team to examine European practices that could be applied specifically to implementing the 511 telephone number for traveler information services.

The report reveals several key findings regarding cost recovery models, new technologies and quality-control measures, and the information content provided under European systems. The report also reviews the national consistency standards and legal issues regarding traveler information systems in various countries.

The panel issued several recommendations, including applying additional resources to close the data gap and improving the quality of traveler information. The panel also recommended incorporating the principle of traveler information into agency and corporate missions.

The report is available at http://international.fhwa.dot.gov/travelinfo/index.htm.

Iowa Introduces Initiative to Reduce Deer-Vehicle Crashes

Approximately 7,400 deer-vehicle crashes are reported every year in Iowa, making up 12 percent of the State's total crashes. The Iowa Department of Natural Resources estimates that the actual number of deer-vehicle crashes is around 12,000. And a number of additional run-off-the-road crashes occur when drivers intentionally swerve to avoid hitting deer or other animals in the roadway. Each year, these crashes result in $13 million in vehicle damage, 600 injuries, and 2 fatalities. Because of a significant increase in the State's deer population (which has doubled since 1985) and the growing number of miles driven on Iowa roadways each year, the potential for deer-vehicle crashes continues to rise.

Iowa is taking a two-pronged approach to reduce deer-vehicle crashes and improve driver safety. The first strategy is to decrease the animal population by increasing the number of deer that can be taken by hunters. The second is launching a public information and education campaign featuring the message: "Don't Veer for Deer."

The campaign features a Web site and a brochure instructing drivers on how to reduce their risk for deer crashes. Motorists are discouraged from veering into oncoming traffic as well as off the roadway. Tips include watching for deer near wooded areas and waterways, and expecting deer to travel in groups. The brochure advises that "striking the animal is often the safest action" and tells motorists to brake firmly, steer to maintain control, and stop as safely as possible.

For more information, visit www.dps.state.ia.us/deercrashes/brochure.htm.

Personnel

ITS Arizona Honors Alan Hansen with Member of the Year Award

In 2003, ITS Arizona—a State chapter of ITS America—celebrated its ninth anniversary and initiated a new award for member of the year. Looking back over the past 10 years, the board of directors for ITS Arizona considered individuals who actively supported the organization from the beginning. This year's award went to Alan Hansen, engineering technology coordinator for the FHWA Division Office in Arizona.

Hansen not only was a founding member of the chapter and served on the original board of directors, but also he contributed to the group's original charter and was active on several committees. Most recently, he helped plan a special meeting on homeland security. Hansen edited the group's newsletter for nearly 3 years, during which time he also wrote eight articles. In addition, he presented at several conferences and annual meetings.

"From one standpoint it was a great honor to be recognized outside of FHWA," Hansen says. "On the other hand, it made me realize that ITS Arizona is truly a group of individuals who work together to move the group forward, and I am really just one of those individuals."

Corrections

In the November/December 2003 issue, the caption for the photograph in the top right-hand corner on page 9 should have read, "TXDOT also used precast, prefabricated components to construct the Lake Belton Bridge in Waco, TX."

TxDOT

In the January/February 2004 issue, on page 19, this photo should have been labeled as a rolling dynamic deflectometer (RDD).

Krammes Named FHWA Engineer of the Year

FHWA recently announced the selection of Dr. Raymond Krammes in the Office of Safety Research and Development at the Turner-Fairbank Highway Research Center in McLean, VA, as the FHWA Engineer of the Year.

Krammes completed extensive work in highway safety, especially in planning, research, development, contract monitoring, and most recently in implementation of the Interactive Highway Safety Design Model. His efforts have been a key component of FHWA's plan to improve highway safety, especially on two-lane roads.

Accompanying the recognition as FHWA Engineer of the Year, Krammes' application now will be sent to the National Society of Professional Engineers for consideration for the Federal Engineer of the Year Award. Krammes also received the FHWA Administrator's Award for Superior Achievement in October 2003.

Reporting Changes of Address

PUBLIC ROADS has two categories of subscribers. One includes the organizations and people who receive the magazine without charge, and the editorial office of the magazine maintains the mailing list for this group. The other category is the group of people and companies that pay to receive the magazine, and the mailing list for this group is maintained by the Superintendent of Documents for the U.S. Government Printing Office.

Free copies are distributed to offices of the Federal Highway Administration, State highway agencies, technology transfer centers, and selected leaders who have a responsibility for highway-related issues. Most of these copies are mailed to offices for their internal distribution or to people by position title rather than by name. If any office or individual subscriber in this category has a change of address, please send the complete previous mailing address and the complete new address to our distribution manager, Martha Soneira, via e-mail (martha.soneira@fhwa.dot.gov), telephone 202–493–3468, or mail (Martha Soneira, PUBLIC ROADS Distribution Manager (HRTS), Federal Highway Administration, 6300 Georgetown Pike, McLean, VA 22101-2296).

Paid subscribers who have an address change should notify the U.S. Government Printing Office, Claims Office, Washington, DC 20402; or call 202–512–1800; or fax 202–512–2168. Please do not send an address change for a paid subscription to the editorial office of PUBLIC ROADS. We do not manage the paid subscription program or mailing list, and we are not able to make the requested change.

Communication Product Updates

Compiled by FHWA's Office of Research and Technology Services

Below are brief descriptions of products recently published online by the Federal Highway Administration's (FHWA) Office of Research, Development, and Technology. Some of the publications also may be available from the National Technical Information Service (NTIS). In some cases, limited copies are available from the Research and Technology (R&T) Product Distribution Center.

When ordering from NTIS, include the NTIS publication number (PB number) and the publication title. You also may visit the NTIS Web site at www.ntis.gov to order publications online. Call NTIS for current prices. For customers outside the United States, Canada, and Mexico, the cost is usually double the listed price. Address requests to:

National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
Telephone: 703–605–6000
Toll-free number: 800–553–NTIS (6847)

Address requests for items available from the R&T Product Distribution Center to:

R&T Product Distribution Center, HRTS-03
Federal Highway Administration
9701 Philadelphia Court, Unit Q
Lanham, MD 20706
Telephone: 301–577–0818
Fax: 301–577–1421

For more information on research and technology publications from FHWA, visit the Turner-Fairbank Highway Research Center's (TFHRC) Web site at www.tfhrc.gov, FHWA's Web site at www.fhwa.dot.gov, the National Transportation Library's Web site at http://ntl.bts.gov, or the OneDOT information network at http://dotlibrary.dot.gov.

Office of Research, Development, and Technology Fiscal Year 2004/2005 Performance Plan Publication No. FHWA-RD-03-085

The performance plan describes the research that the FHWA Office of Research, Development, and Technology (RD&T) will conduct and the products and services it will provide in fiscal year (FY) 2004/2005. The document discusses the strategic framework for research, identifies challenges and commitments, and explains the organization of the Office of RD&T. In addition, the plan communicates the benefits of RD&T's research and technical services and outlines specific activities planned for FY 2004/2005.

The plan is based on the RD&T mission of championing the advancement of highway technological innovation. It outlines RD&T's key functions supporting FHWA's strategic goals and performance objectives, including highway research and development (R&D), outreach activities, and implementation of the strategic planning and budgeting outlined in the FHWA *Corporate Master Plan for Research and Deployment of Technology & Innovation*.

The publication includes charts listing research projects planned for FY 2004/2005 and target completion dates. The Office of Infrastructure R&D, which focuses on improving the performance and reducing the costs of highway infrastructure, plans to conduct research on pavement design and analysis, bridge innovations and safety, and infrastructure stewardship.

The Office of Operations R&D, which concentrates on mitigating congestion and improving operations safety, has proposed research in the areas of traffic control and operations, traffic analysis tools, and human-centered systems. The Office of Safety R&D, whose mission is to reduce highway crashes and related fatalities and injuries, plans research on preventing and mitigating roadway departures, managing safety, improving intersections, and protecting pedestrians.

The document is available online at www.tfhrc.gov/about/03085/index.htm.

Long-Term Pavement Performance Information Management System Pavement Performance Database User Guide Publication No. FHWA-RD-03-088

This report provides information to help researchers understand and use the performance database of the Long-Term Pavement Performance (LTPP) program—a comprehensive study of pavements to improve design, rehabilitation, and maintenance practices.

The document contains an introduction to the structure of the LTPP program, the relational structure of the LTPP database, a description of the location of various data elements, and contents of the data table. The publication offers tips on how to obtain data and efficient means of manipulating data for specific types of investigations. It also provides examples of structured query language (SQL) scripts for accessing and manipulating LTPP data. Users can apply the SQL scripts to build and analyze custom data sets.

To access the guide online, visit www.datapave.com/Downloads/IMS_Database_Users_Guide.pdf.

Key Findings from LTPP Analysis 2000–2003 Publication No. FHWA-HRT-04-032

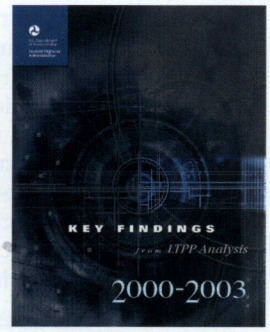
This document highlights key findings from analysis studies of the LTPP program completed between 2000 and 2003. The LTPP program, established in 1987, is a 20-year study of inservice pavements using a series of field experiments to monitor more than 2,400 asphalt and portland cement concrete pavement test sections across the United States and Canada. The program's goal is to determine why some pavements outperform others.

About 50 projects are described in the report, including research reports and National Cooperative Highway

Research Program projects using LTPP data. The publication includes sections on pavement site conditions, structural features, material characterization, initial roughness, and maintenance. It also includes a section on local calibration of the *2002 Pavement Design Guide* (FHWA-RD-00-129).

The goal of the report is to provide information to those participating in the LTPP program that will help them design, build, and maintain cost-effective and long-lasting pavements. The report follows the publication in 2000 of *Key Findings from LTPP Analysis 1990–1999* (FHWA-RD-00-085).

LTPP: Year in Review 2003
Publication No. FHWA-HRT-04-041



This report outlines the 2003 accomplishments of the LTPP program and previews the year ahead. In 2003, the LTPP program continued to emphasize the importance of collecting reliable data to help researchers answer how and why pavements perform the way they do.

The LTPP program collects most of the data, although State agencies provide traffic and materials data for Specific Pavement Studies (SPS) projects. LTPP developed a two-phase, pooled fund study in 2000 to address inconsistencies and inadequacies in traffic data supplied for SPS projects. The project is designed to improve the quality and quantity of traffic data from the projects. In August 2003, FHWA awarded the contract for Phase I, which consists of assessing, evaluating, and calibrating weigh-in-motion (WIM) systems.

FHWA plans to award the contract for Phase II—which involves procuring, installing, and maintaining the LTPP WIM equipment—in early 2004. Phase I traffic evaluations were completed in a few States in 2003 and are continuing in 2004.

FHWA achieved its goal of processing the 1999–2001 traffic data for all LTPP test sections nationwide by December 2003. Improvements made to the LTPP traffic quality control and analysis software helped the LTPP regions accomplish the goal. As a result, the pavement community has access to a large quantity of new traffic data in 2004.

The LTTP program also continued work on an action plan to address gaps in the materials database for SPS projects. Participating States worked to complete testing on their SPS project materials, and they continued their resilient modulus testing on bound and unbound materials. New protocols were developed for the bending beam rheometer, dynamic shear rheometer, dynamic cone penetrometer, soil suction, and specific gravity for unbound materials.

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Martha M. Soneira, Editor-in-Chief. Date: January 14, 2004.

Internet Watch

by Keri A. Funderburg

Measuring the Accuracy of Online Travel Times

On any given morning, millions of people rush out the door and into their cars to drive to work. In the evening, most people are anxious to get home quickly to spend time with their families or relax after a long day at work. Whether at the beginning or the end of the day, many people are turning to Web sites that report estimated travel times as a means to identify the fastest routes to and from work. Because so many people rely on these estimates to make travel decisions, the accuracy of the data is critical. Recently, the Federal Highway Administration (FHWA) and the University of Central Florida (UCF) released two reports that explore the accuracy of online travel estimates.

Hands-On Approaches to Improving Accuracy

In June 2003, FHWA published *Travel Time Data Collection for Measurement of Advanced Traveler Information Systems (ATIS) Accuracy* (Contract No.: DTFH61-00-C-00001). The report recommends approaches to measuring travel time accuracy for planners who specialize in intelligent transportation systems.

According to the report, transportation agencies can use several technologies and techniques for collecting data to measure the accuracy of travel time estimates. Inductive loop sensors that measure vehicle speeds at various points along a roadway are the most common technique. Loop sensors, however, can be unreliable for measuring low speeds. In addition, loop sensors measure vehicle speed, rather than actual travel time.

License plate matching is another technique, in which observers or computers match vehicle license plates at two points and measure the travel time between the points. Sometimes transportation agencies use geographic positioning systems (GPS) to capture information and data collection vehicles with an observer recording travel times at predefined points.

The report recommends that transportation agencies use both data collection vehicles and license plate matching in a two-step approach. First, transportation agencies should use probe vehicles to collect 100 data points to measure ground-truth travel times. Data collection vehicles are most appropriate because researchers can use them to take many samples over an entire traffic network. Next, agencies should measure the day-to-day variability of traffic patterns using license plate matching, which is the most accurate and reliable measurement technique for this purpose. By combining the two techniques and comparing them to the data presented in online estimates, transportation agencies will gain a better understanding of the accuracy of their information.

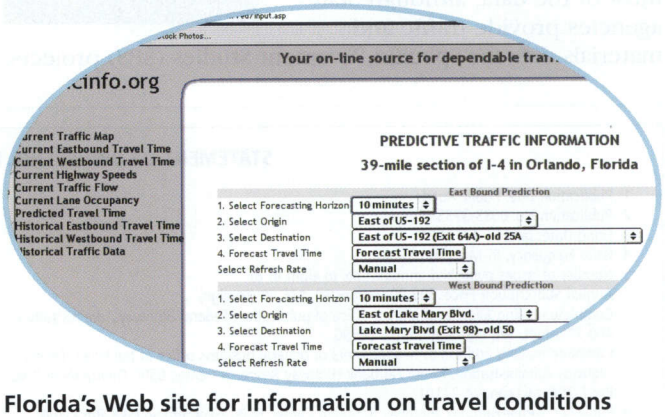
Researchers estimate that using probe vehicles equipped with GPS to collect 100 observations would cost approximately $21,000, which includes using two vehicles, GPS equipment, and staff to perform the collection. Collecting 20 days of data using license plate matching would cost approximately $48,100, including staff, equipment rental, and data transcription.

Statistical Analysis to Measure Estimate Accuracy

For UCF's report, *The Impact of Real-Time and Predictive Traffic Information on Travelers' Behavior in the I-4 Corridor*, researchers performed statistical analyses to evaluate the short-term prediction system used to estimate the travel times posted at www.trafficinfo.org. The travel times were exclusively for trips along a 64-kilometer (40-mile) corridor of Interstate 4 in Orlando, FL.

Travel time estimates for the Florida Web site are based on data from 70 loop detector stations and closed-circuit television cameras. The estimates are calculated using two prediction models. The short-term model, which UCF analyzed in this report, uses real-time estimates to make predictions. The long-term model also provides estimates but uses travel time information based on historical data.

Analysis of the short-term model showed that the travel times posted on the Web were less accurate during heavy congestion and more accurate during lighter congestion—most likely due to random fluctuations in travel speed during heavy congestion. The analysis also showed that when predicting travel times in the near future (within 15 minutes), the system became increasingly inaccurate as the estimates moved further into the future. In addition, the analysis revealed that the prediction system had a slight tendency to underestimate travel times.



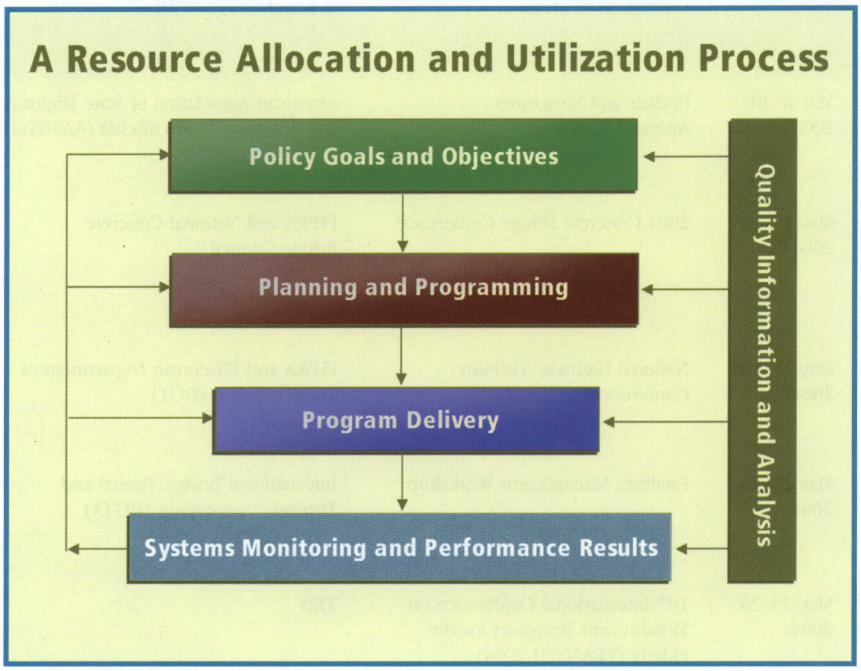
Florida's Web site for information on travel conditions along Interstate 4.

Rigorous analysis and real-world data are the keys to evaluating travel time estimates and ensuring the accuracy of traveler information. For more information about FHWA's study, visit www.itsdocs.fhwa.dot.gov/JPODOCS/REPTS_TE/13867.html. To download UCF's report, go to www.dot.state.fl.us/research-center/Completed_Proj/Summary_TE/FDOT_BC355_03.pdf.

Keri A. Funderburg is a contributing editor for PUBLIC ROADS.

New Course Provides Instruction on Managing Assets

Today's transportation environment is characterized by high user demand, stretched budgets, declining staff resources, and a system that shows the signs of age. The public has made significant investments in constructing, maintaining, and operating the Nation's highways, and taxpayers expect Federal, State, and local agencies to be responsible stewards of those investments. Decisions about whether to repave a highway or build a new bridge involve a complex web of considerations, including the time horizon, economic and engineering factors, and the existing range of assets. Using increasingly powerful computer systems, agency personnel now can assess the tradeoffs among alternative investment options by performing sophisticated analyses of their assets. By evaluating how they manage their infrastructure, transportation officials can make more informed decisions about future investments.



Instructors use this diagram during the course to reinforce the idea that transportation personnel manage assets to obtain policy goals and objectives throughout the planning, program delivery, and monitoring processes.

In 1999, the Federal Highway Administration (FHWA) established the Office of Asset Management, affirming its commitment to helping the Nation's transportation agencies manage their assets more effectively. To fulfill this commitment, FHWA's National Highway Institute is offering a new course, Transportation Asset Management (#131106). The 1-day course targets senior-level executives and managers from different functional lines and units, such as planning, engineering, capital programming, financial management, maintenance and operations, traffic and safety, system operation and management, and information technology. Instructors will introduce attendees to the concepts and principles of asset management through examples of techniques currently used in transportation agencies.

"Asset management enables transportation agencies to fulfill their stewardship role by ensuring a good return on every tax dollar invested in the transportation system by their customers," FHWA Administrator Mary E. Peters noted in her remarks at the pilot offering of the course. "The asset management training course will provide agencies with many useful tools and techniques as they move toward this new way of doing business."

During the course, participants apply lessons from the *Transportation Asset Management Guide* (NCHRP Project 20-24(11)), recently published by the National Cooperative Highway Research Program. The guide defines asset management, describes state-of-the-art practices, and provides examples of effective practices in four functional areas: policy development; planning and programming; program delivery; and information, analysis, and performance monitoring. A noteworthy feature is the guide's self-assessment tool, which agencies can use to characterize their existing practices and identify specific opportunities for improvement.

The interactive course combines presentations with class discussions and exercises, including a session devoted specifically to completing and interpreting the results of the self assessment. Participants also take part in an exercise that involves helping a hypothetical State transportation agency allocate resources and manage its assets under budget constraints.

Using the self-assessment tool, exercises, and real-world examples, participants learn how to organize their thoughts on managing assets, structure an agenda for detailed planning, and develop consensus among top-level managers on the strengths of the agency and areas that require improvement.

For further information on the course, visit NHI's Web site at www.nhi.fhwa.dot.gov/coursedesc.asp?coursenum=1130 or contact John Taylor at 703-235-0524 or john.taylor@fhwa.dot.gov. To learn more about transportation-related training courses available from NHI, consult the course catalog at www.nhi.fhwa.dot.gov or contact NHI at 4600 N. Fairfax Drive, Suite 800, Arlington, VA 22203; 703-235-0500 (phone); or 703-235-0593 (fax). For scheduling, contact Danielle Mathis-Lee at 703-235-0528 or danielle.mathis-lee@fhwa.dot.gov.

Conferences/Special Events Calendar

Date	Conference	Sponsor	Location	Contact
April 21-23 2004	5th Biennial Workshop: Interstate Technical Group on Abandoned Underground Mines	Federal Highway Administration (FHWA) and Transportation Research Board (TRB)	Tucson, AZ	Nick Priznar 602-712-8089 npriznar@dot.state.az www.fhwa.dot.gov/mine/arizona.htm
May 6-20 2004	Bridges and Structures Annual Meeting	American Association of State Highway and Transportation Officials (AASHTO)	Orlando, FL	William Nickas, FDOT Nedra Heath, FDOT 850-414-4259 nedra.heath@dot.state.fl.us
May 17-18 2004	2004 Concrete Bridge Conference	FHWA and National Concrete Bridge Council	Charlotte, NC	Shrinivas Bhide, NCBC 847-972-9100 sbhide@portcement.org www.nationalconcretebridge.org
May 18-19 2004	National Highway Visibility Conference	FHWA and Wisconsin Department of Transportation (DOT)	Madison, WI	Todd Szymkowski 608-263-2684 szymkowski@engr.wisc.edu www.topslab.wisc.edu/nhvc
May 22-26 2004	Facilities Management Workshop	International Bridge, Tunnel and Turnpike Association (IBTTA)	Denver, CO	Nicole Neuman 202-659-4620 nneuman@ibtta.org www.ibtta.org
May 23-26 2004	10th International Conference on Mobility and Transport for the Elderly (TRANSED 2004)	TRB	Hamamatsu, Japan	Tetsuo Akiyama +81-3-3221-6673 info@transed.jp http://transed.jp
June 7-9 2004	International Symposium on the Design and Construction of Long-Life Asphalt Pavements	International Society for Asphalt Pavements	Auburn, AL	Dr. Ray Brown 334-844-6228 taplecp@eng.auburn.edu www.asphalt.org
June 21-23 2004	41st Annual Petersen Asphalt Research Conference	Western Research Institute	Cheyenne, WY	Jackie Greaser 307-721-2249 jgreaser@uwyo.edu www.petersenasphaltconference.org
June 21-23 2004	Geotechnical Management System Workshop	FHWA and Consortium of Organizations For Strong Motion Observation Systems	California	Carl Stepp 830-833-5446 cstepp@moment.net
June 22 2004	Expanded Polystyrene Geofoam Showcase	Rhode Island Transportation Center, Rhode Island DOT, FHWA, Rhode Island Local Technical Assistance Program (LTAP) and Florida LTAP	North Kingstown, RI	Chris Ritch 352-392-2371, ext. 223 chris@ce.ufl.edu www.pdshowcase.org
July 27-31 2004	Geo-Trans 2004	American Society of Civil Engineers (ASCE)	Los Angeles, CA	Leonore Jordan 703-295-6110 ljordan@asce.org www.asce.org/conferences/geotrans04
August 1-4 2004	ITE 2004 Annual Meeting and Exhibit	ITE	Lake Buena Vista, FL	Lisa Zahurones 202-289-0222, ext. 136 lzahurones@ite.org www.ite.org
Sept 3-8 2004	National Civil Rights Conference	AASHTO	San Diego, CA	Hanna Whitney 202-624-5800 hannaw@aashto.org www.dot.ca.gov/hq/bep/conference/aashto_index.htm

American Hiking Society

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On June 5, 2004, celebrate National Trails Day.

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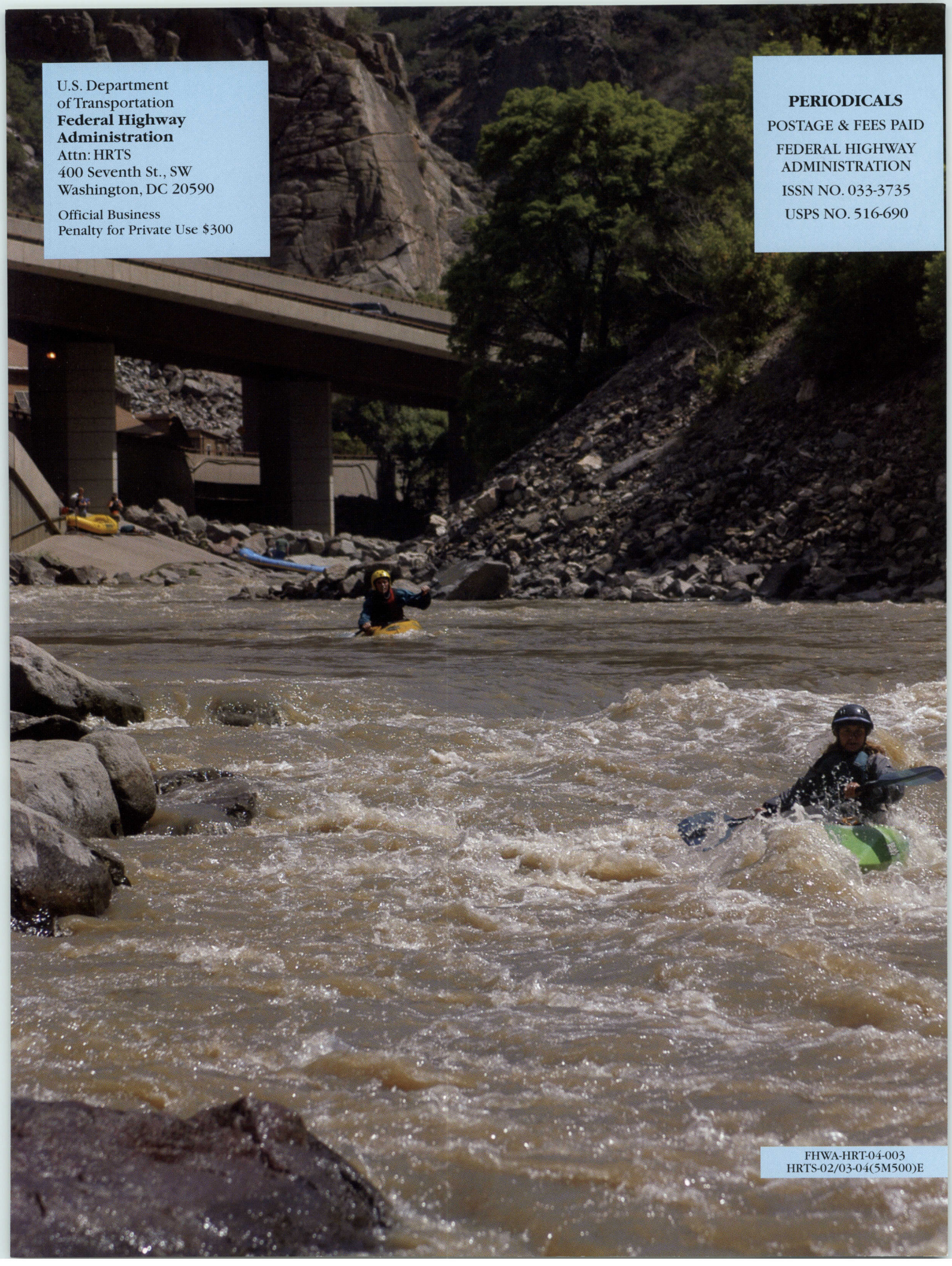
National Trails Day®

American Hiking Society

June 5, 2004

Above, pedestrians stroll on the East River Esplanade along FDR Drive in New York City, part of a shared-use pathway that will encircle Manhattan and provide a link in the East Coast Greenway—a more than 4,200-kilometer (2,600-mile) traffic-free path linking cities from Maine to Florida. Photo: Karen Votava, East Coast Greenway Alliance



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